

STUDIES OF PACIFIC ISLAND PLANTS, XXVIII.  
THE GUTTIFERAE OF THE FIJIAN REGION <sup>1</sup>

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THE MOST COMPREHENSIVE REVIEWS of the large and complex family Guttiferae (Clusiaceae) have been those of Vesque (1889, 1893) and Engler (1925), but the family remains taxonomically difficult in many parts of its pantropical range. With the primary aim of clarifying the taxonomy and nomenclature of the Fijian components, we have reviewed much of the herbarium material available from the Fijian Region, the area extending from the Santa Cruz Islands and the New Hebrides to Tonga and Samoa. Only three genera are indigenous in this area: *Calophyllum*, with nine species, *Mammea*, with two species, and *Garcinia*, with five species. Of the 16 species here treated, four are described as new. Generic classifications in the Guttiferae are still unsatisfactory, Vesque having followed Planchon & Triana (1860-62) in utilizing certain anatomical characters that are of questionable taxonomic utility. For instance, it is not feasible readily to determine whether the cotyledons are large and the radicle minute, as in *Calophyllum*, or whether the cotyledons are small and the bulk of the seed composed of a tigellus, as indicated for *Garcinia* by Vesque and Engler but questioned by Kostermans (1956). The genera of our area are readily recognized by the gross characters used in the key below, although such a key may not reflect the entire composition of the genera.

We express our appreciation to the administrators of the following institutions who have made their herbarium collections available to us: Arnold Arboretum of Harvard University (A); Bernice P. Bishop Museum (BISH); British Museum (Natural History) (BM); Gray Herbarium of Harvard University (GH); Royal Botanic Gardens, Kew (K); Department of Botany, University of Massachusetts (MASS); New York Botanical Garden (NY); Muséum National d'Histoire Naturelle, Paris (P); Departments of Agriculture and Forestry, Suva, Fiji (SUVA); University of California, Berkeley (UC); and U. S. National Herbarium (US).

KEY TO GENERA INDIGENOUS IN THE FIJIAN REGION

Plants polygamo-dioecious or with consistently hermaphrodite flowers; stamens free or essentially so, with filiform filaments; ovary unilocular or (in our

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species of *Mammea*) 4-locular and soon becoming unilocular by abortion; fruits with a single seed; leaf-blades with regular venation composed of closely parallel secondary and tertiary nerves.

Leaf-blades with veinlets not forming a conspicuous reticulum, the ultimate areoles not conspicuous nor with a central gland; inflorescences appearing racemose (or reduced and more obviously cymose), the flowers hermaphrodite; calyx composed of 4 decussate sepals; style obvious. ....

1. *Calophyllum*.

Leaf-blades with veinlets forming a conspicuous reticulum, the ultimate areoles depressed in dried leaves and with a raised gland in the center; inflorescences fasciculate, the flowers ♂ or ♀ on different trees; calyx composed of 2 sepals completely fused in bud but separating at anthesis; style short or essentially none. ....

2. *Mammea*.

Plants dioecious; androecium diverse, the stamens aggregated into one or more phalanges; ovary with 2 or more developing ovules and fruits with 2 or more seeds; leaf-blades often with comparatively spaced secondary nerves, or the secondaries, if crowded, not regularly paralleled by conspicuous tertiaries; inflorescences (in our species) cymose or fasciculate or glomerulate, the flowers with 4-8 decussate perianth-segments. ....

3. *Garcinia*.

# 1. *Calophyllum* L. Sp. Pl. 513. 1753; Seem. Fl. Vit. 11. 1865.

The sections of *Calophyllum* recognized by Vesque (1889, 1893), Lauterbach (1922), and Engler (1925) seem artificial and scarcely useful, since inter-relationships among species are probably too complex to permit meaningful infra-generic classification at our present state of knowledge. It seems possible that in the western Pacific a single highly vagile strand species, *C. inophyllum* L., has locally given rise to many inland derivatives. These local forms are often superficially similar in different regions (e.g., in Melanesia, Papuasia, Malesia, etc.), but one may doubt that they are genetically closely related among themselves. For instance, the Solomon Island specimens that have been identified as *C. vitiense* and *C. cerasiferum* are now considered to represent distinct taxa (P. F. Stevens, personal communication). Among species of the Fijian Region, it seems likely that *C. inophyllum* and perhaps *C. samoense* have fruits with a specific gravity that permits them to be successfully dispersed by ocean currents. Other species would appear to have heavier fruits in proportion to their size, and the transport of such fruits over significant water barriers is questionable.

The species of our region are trees, sometimes among the larger of the forests and sometimes locally abundant, with pale yellow or white latex. Vegetative and inflorescence parts are characteristically glabrous, but the terminal buds are usually closely and evanescently puberulent (FIGURE 4); the indument is obvious and subpersistent in only one of our species (FIGURE 1). The branchlets are subquadrangular or slightly flattened in the distal internodes, soon becoming terete, and brownish to gray in color. The opposite leaves have distinct petioles that broaden into often thick-textured and glossy leaf-blades, these drying dark green to olive-brown and usually paler beneath, with very close, parallel, spreading secondary



nerves that terminate in the thickened and usually narrowly revolute margin. The inflorescences are solitary, axillary, pseudo-racemose but sometimes reduced and obviously cymose, few- to many-flowered, and with a short peduncle and a rachis that are bluntly angular and soon subterete. The flower-subtending bracts are small and caducous in very young bud, leaving transversely narrow scars on inconspicuous swellings. The flowers are pedicellate, opposite or subopposite, and hermaphrodite, with 4 papyraceous decussate sepals with numerous and obvious parallel nerves (FIGURES 7, 14). The petals in some of our species are lacking, in others 4 and decussate (FIGURES 8, 15), and in still others more numerous and imbricate; when present they resemble the sepals in texture and venation or may be somewhat more membranous. The stamens (FIGURES 12, 21) are numerous, 2-several-seriate, essentially free but with slender, filiform filaments that are subcoherent toward the base; the anthers are basifixed, oblong, and rounded at both ends, dehiscing by lateral clefts. The ovary (FIGURES 8, 12, 15) is essentially globose, unilocular, with a single, erect, anatropous ovule; the style is terete, often filiform but sometimes comparatively carnose, with a peltate or shallowly infundibular stigma. The fruit (FIGURE 2) is an indehiscent drupe, subglobose to ellipsoid, usually rounded at base and apex, sometimes with subpersistent perianth-segments and stamens at base, and often surmounted by the base of the subpersistent style. The exocarp is thin, drying to a somewhat brittle texture; the mesocarp is sometimes fibrous and compact (FIGURES 3, 20) and not much altered in drying, but sometimes spongy and greatly shrinking in drying (FIGURES 10, 13), leaving air-spaces between the exocarp and endocarp; the endocarp is bony or crustaceous and is usually very durable. The single seed is erect, the testa being 2-layered and variable. The inner layer remains thin and fragile, but the outer integument develops into a spongy layer closely adherent to the endocarp. In occasional sterile fruits this spongy layer fills the cavity except for a small central opening (FIGURE 11), but normally it is compressed by the developing cotyledons (FIGURES 10, 13, 19), remaining conspicuous in mature fruits, among our species, only in *Calophyllum inophyllum* (FIGURE 6).

The above characters being more or less generic in nature, they are not repeated in the following descriptions unless especially significant. Although *Calophyllum* is a notoriously difficult genus in which to express taxonomic distinctions, we find that the species of the Fijian Region are reasonably well characterized. Flower size and the number (or absence) of petals seem dependable within limits, but most available collections have been prepared in fruiting condition. Usable fruiting characters refer to size and color, the thickness and texture of the mature mesocarp and endocarp, and the nature of the outer integument of the seed at maturity. Vegetative characters, although variable, seem useful in respect to the robustness of branchlets and petioles, and in respect to the leaf-blades as to texture, size, proportions, apex, and, within very broad limits, the number of secondary nerves.



In the Fijian Region we now recognize nine species of *Calophyllum*, of which three are here described as new. The circumscriptions of others are altered by study of types and many recent collections; only *C. inophyllum* has a broad distribution outside our area.

#### KEY TO SPECIES

Petals none; flowers small, 6–10 mm. in diameter at anthesis, the sepals not more than 4 mm. long; stamens 40–60; inflorescences cymose or pseudoracemose, congested, less than 4.5 cm. long in fruit; fruits comparatively small,  $9\text{--}17 \times 9\text{--}15$  mm. at maturity and apparently white, the mesocarp compactly fibrous and thin, the endocarp thin, 0.2–0.8 mm. thick; slender inland plants, the branchlets 1–2 mm. in diameter toward apex, the petioles not exceeding 15 mm. in length, the leaf-blades rarely exceeding  $9 \times 3$  cm.; Fiji.

Indument of buds, young branchlets, young petioles, and peduncles conspicuous, the hairs copious, spreading, 0.3–0.5 mm. long; pedicels not exceeding 5 mm. long in fruit; stamens 40–45; apparently mature fruits 9–12 mm. in diameter, the endocarp 0.2–0.3 mm. thick. . . . . 1. *C. leucocarpum*.

Indument of buds and young parts minutely and evanescently sericeous-puberulent; pedicels 4–13 mm. long; stamens about 60; mature fruits 12–17 mm. in diameter, the endocarp 0.4–0.8 mm. thick. . . . .

. . . . . 2. *C. leptocladum*.

Petals present; flowers larger, at least 10 mm. in diameter at anthesis, the sepals at least 4 mm. long; stamens at least 80; inflorescences appearing racemose and comparatively extended; fruits at maturity usually larger than  $17 \times 15$  mm. and glaucous to purple or black; comparatively robust plants, the branchlets usually more than 2 mm. in diameter toward apex.

Leaves variable in size but usually with petioles 6–35 mm. long and blades  $5\text{--}30 \times 2\text{--}11$  cm.; pedicels usually 8–42 mm. long; flowers 10–30 mm. in diameter at anthesis, the sepals  $4\text{--}15 \times 4\text{--}12$  mm., the petals always 4 (in our observation),  $5\text{--}16 \times 3\text{--}10$  mm.; mature fruits usually  $22\text{--}50 \times 15\text{--}40$  mm., the pericarp variable, the mesocarp compactly fibrous or spongy, the endocarp 0.4–3.5 mm. thick.

Trees of the strand, rarely occurring inland; mature fruits  $32\text{--}50 \times 27\text{--}40$  mm., buoyant in sea water, the outer layer of the seed-testa spongy, 1–12 mm. thick, not much compressed by the developing cotyledons; leaf-blades elliptic- to ovate-oblong,  $10\text{--}23 \times 5\text{--}11$  cm., about twice as long as broad, usually obtuse to rounded at apex, the secondary nerves usually 10–16 per centimeter; flowers 15–30 mm. in diameter at anthesis; a widespread and vagile species. . . . . 3. *C. inophyllum*.

Trees of inland forests, if occurring at sea-level not typical of the strand; mature fruits not exceeding  $40 \times 30$  mm., not buoyant in sea water (except perhaps in no. 5), the outer layer of the seed-testa compressed by the developing cotyledons and not exceeding 4 mm. in thickness; leaf-blades lanceolate to oblong-elliptic, rarely exceeding 7.5 cm. in width, usually 2.5–4 times as long as broad; flowers 10–23 mm. in diameter at anthesis.

Flowers comparatively large, 20–23 mm. in diameter at anthesis, the sepals  $7\text{--}15 \times 7\text{--}12$  mm., the petals  $9\text{--}16 \times 7\text{--}10$  mm.; mature fruits with a fibrous-spongy mesocarp 2–5.5 mm. thick, this often shrinking or collapsing in drying, the endocarp (1.8–) 2–3.5 mm. thick; leaf-



blades lanceolate or narrowly elliptic, 3–4 times as long as broad, usually  $13\text{--}30 \times 3\text{--}7.5$  cm. and acuminate to acute at apex, the secondary nerves usually 11–20 per centimeter; Fiji.

4. *C. vitiense*.

Flowers smaller, 10–18 mm. in diameter at anthesis, the sepals  $4\text{--}10.5 \times 4\text{--}7.5$  mm., the petals  $5\text{--}11 \times 3\text{--}6.5$  mm.; mature fruits with an endocarp 0.4–1.5 mm. thick; leaf-blades often smaller and 2–3 times as long as broad, infrequently exceeding  $17 \times 7$  cm., the secondary nerves 12–30 (or more) per centimeter.

Mature fruits with a fibrous-spongy mesocarp 3.5–6 mm. thick, this often shrinking or collapsing in drying; leaf-blades ovate- to oblong-elliptic, usually  $6.5\text{--}17 \times 2\text{--}7$  cm., obtuse to short-acuminate at apex; Samoa, Horne Islands, and eastern (Lau) group of Fiji.

5. *C. samoense*.

Mature fruits with a compactly fibrous mesocarp 1–4 mm. thick; leaf-blades elliptic to lanceolate or narrowly ovate-oblong, usually  $5\text{--}17 \times 2\text{--}5.5$  cm.

Petioles slender, 1–1.8 mm. in diameter, the leaf-blades obtuse to obtusely cuspidate at apex; flowers 10–16 mm. in diameter at anthesis; mature fruits  $17\text{--}35 \times 13\text{--}28$  mm., the endocarp 0.4–1 mm. thick; New Hebrides.

6. *C. neo-ebudicum*.

Petioles comparatively robust, often 3.5 (–5) mm. in diameter, the leaf-blades rounded to obtuse at apex or occasionally obtusely short-cuspidate; flowers 12–18 mm. in diameter at anthesis; mature fruits  $25\text{--}40 \times 20\text{--}30$  mm., the endocarp 0.5–1.5 mm. thick; Fiji, Tonga, and Niue.

7. *C. amblyphyllum*.

Leaves comparatively small, the petioles 3–16 mm. long, the blades not exceeding  $10 \times 5$  cm. and usually smaller; pedicels not exceeding 13 mm. in length even in fruit; flowers 12–20 mm. in diameter at anthesis, the sepals not much exceeding  $9 \times 6$  mm., the petals often more than 4, sometimes as many as 10, not exceeding  $10 \times 6$  mm.; mature fruits not exceeding 25 mm. in diameter, the pericarp 1.5–4 mm. thick, the mesocarp thin and compactly fibrous, less than 3 mm. thick, the endocarp 1–1.5 mm. thick; Fiji.

Leaf-blades elliptic-oblong to ovate or obovate,  $3.5\text{--}8 \times 1.3\text{--}5$  cm., usually less than twice as long as broad; young parts and buds essentially glabrous, sometimes obscurely glandular-puberulent; petals often 4 but frequently as many as 10; fruits subglobose, the mesocarp 1–3 mm. thick.

8. *C. cerasiferum*.

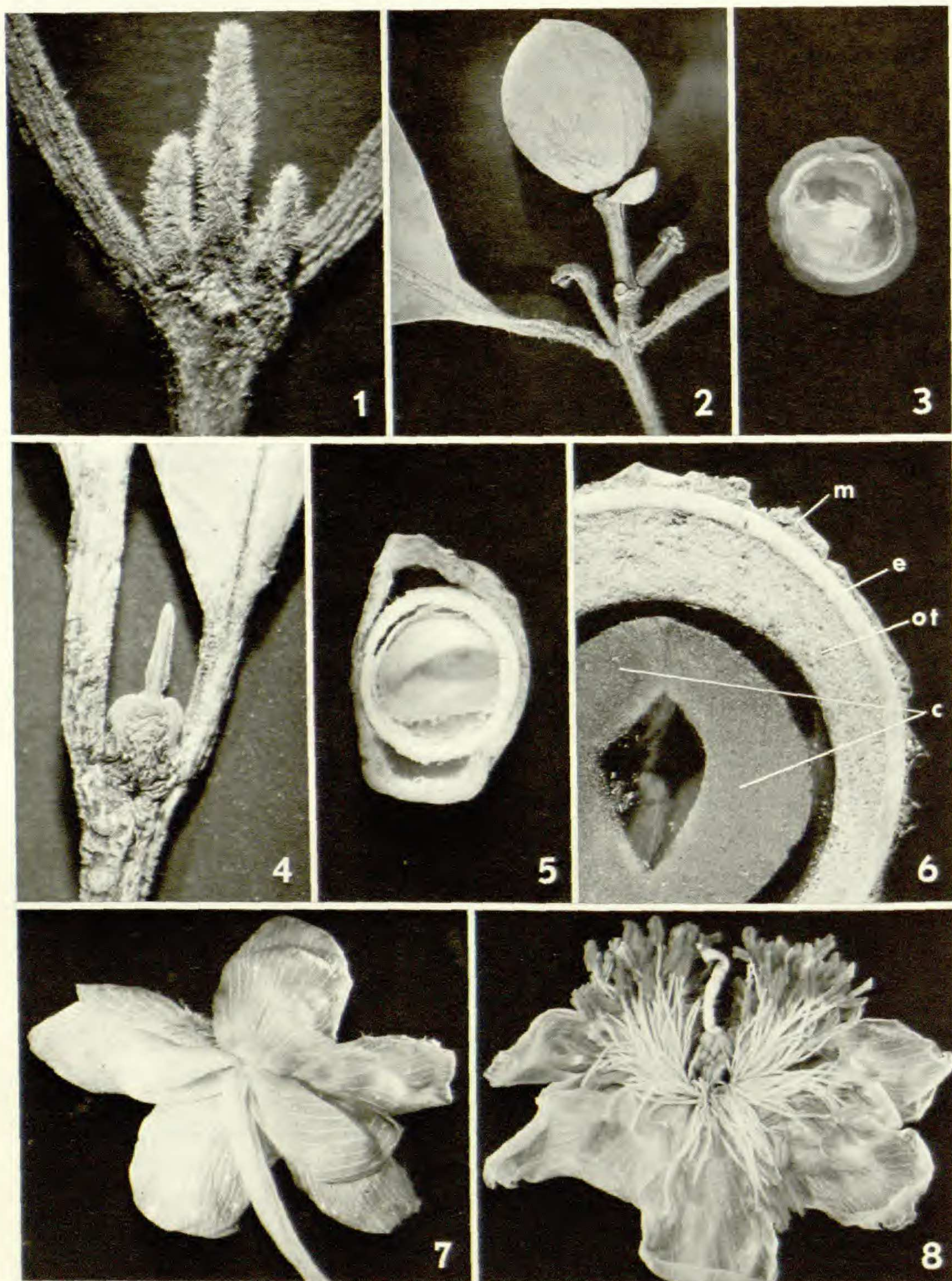
Leaf-blades narrowly elliptic to lanceolate-oblong,  $5\text{--}10 \times 2\text{--}3.5$  cm., usually about 3 times as long as broad; young parts and buds copiously but minutely tomentellous with glandular hairs, soon glabrate; petals 4–6 (as far as known); fruits ovoid-ellipsoid, obviously longer than broad, the mesocarp negligible, 0.2–0.5 mm. thick.

9. *C. tenuicrustosum*.

1. ***Calophyllum leucocarpum*** A. C. Sm. in Jour. Arnold Arb. 31: 314. 1950; J. W. Parham, Pl. Fiji Isl. 134. 1964. FIGURES 1–3.

Slender tree to 4 m. high, the young parts and terminal buds copiously hispidulous with hairs 0.3–0.5 mm. long, the indument subpersistent on





FIGURES 1-3. *Calophyllum leucocarpum*: all from *Smith 6820*. 1, tip of branchlet, showing petiole-bases, terminal bud, and axillary buds,  $\times 5$ ; 2, fruiting inflorescence,  $\times 2$ ; 3, cross section of fruit,  $\times 2$ . FIGURES 4, 5. *Calophyllum leptocladum*: 4 from *Smith 7538*, 5 from *Smith 7874*. 4, tip of branchlet, showing petioles and terminal bud,  $\times 5$ ; 5, cross section of fruit,  $\times 2$ . FIGURES 6-8. *Calophyllum inophyllum*: 6 from *Smith 7944*, 7 from *O. & I. Degener 32219*, 8 from *Smith 8101*. 6, cross section of fruit,  $\times 2$ ; 7, proximal surface of flower,  $\times 2$ ; 8, open flower,  $\times 2$ . m = mesocarp; e = endocarp; ot = outer layer of testa; c = cotyledons.



the young branchlets, young petioles, and peduncles, the branchlets slender, 1–1.5 mm. in diameter toward apex, at length glabrate; petioles slender, canaliculate, (8–) 10–15 mm. long, at length glabrate; leaf-blades coriaceous, oblong-lanceolate, (4–) 5–7.5 cm. long, (1.5–) 2–3 cm. broad, attenuate at base and obviously decurrent on the petiole, obtusely cuspidate at apex, the costa sharply elevated on both sides, somewhat hispidulous beneath when young, the secondary nerves 12–22 per centimeter, slightly impressed above and prominulous beneath; inflorescences congested, once- or twice-branched, 3–5-flowered, about 1 cm. long at anthesis and to 2 cm. long in fruit, glabrous except for the subpersistently pilose peduncle, the pedicels 0.5–3 mm. long at anthesis, to 5 mm. long in fruit; flowers 8–10 mm. in diameter at anthesis, the sepals suborbicular to obovate, obscurely ciliolate, the outer ones about  $2.5 \times 3.5$  mm., the inner ones to 4 mm. long; petals none; stamens 40–45, more or less biseriate, the filaments about 2 mm. long at anthesis, the anthers 0.6–0.8 mm. long; style about 1 mm. long, the stigma peltate; apparently mature fruits subglobose to ellipsoid,  $9\text{--}12 \times 9\text{--}10$  mm., the mesocarp densely fibrous, 0.6–1.2 mm. thick, the endocarp crustaceous, 0.2–0.3 mm. thick.

TYPE LOCALITY: Seanggangga Plateau, Mathuata Province, Vanua Levu, Fiji; the type is *Smith 6820*.

DISTRIBUTION: Known only from the type collection, occurring in patches of forest in open rolling country at an elevation of 100–200 m., as a slender tree 4 m. high; the sepals and filaments are white, the anthers yellow, and the fruit white. It is surprising that no additional collections of this plant have been obtained, although the area has been visited by other collectors. Nevertheless, the drainage basin of the Ndreketi River in Vanua Levu requires further field work; another example of this unexpectedly local endemism is seen in the rubiaceous *Gardenia candida* (Smith, 1974: 120), represented only by its type collection from the same locality.

Fiji. VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, Dec. 4, 1947, *Smith 6820* (A holotype; isotypes at BISH, K, NY, US).

The present species and the following novelty are the only taxa of *Calophyllum* in the Fijian Region to lack petals; additionally they are characterized by their slender habit, small leaves and flowers, comparatively few stamens, and small, white fruits with a thin and fibrous mesocarp and a thin endocarp.

## 2. *Calophyllum leptocladum* A. C. Sm. & S. Darwin, sp. nov.

FIGURES 4, 5.

*Calophyllum neo-ebudicum* sensu J. W. Parham, Pl. Fiji Isl. ed. 2. 192, p. p. 1972; non Guillaumin.

Arbor ad 21 m. alta praeter partes juveniles et gemmam terminalem minute et evanescenter sericeo-puberulas ubique glabra, ramulis gracilibus



apicem versus 1–2 mm. diametro; petiolis gracilibus leviter canaliculatis 4–13 (–15) mm. longis; foliorum laminis tenui-coriaceis lanceolatis vel oblanceolatis vel anguste oblongo-ellipticis, 3–9 (–11.5) cm. longis, 1–3.2 cm. latis, basi acutis vel attenuatis et in petiolum longe decurrentibus, apice obtuse brevi-cuspidatis, costa supra vadosa canaliculata vel subplana subtus peracute elevata, nervis secundariis (16–) 22–36 (–40) per centimetrum utrinque subplanis vel paullo prominulis; inflorescentiis pauciramosis 3–7-floris sub anthesi 1.5–2.5 cm. sub fructu ad 4.5 cm. longis pedunculo sub anthesi ad 6 mm. sub fructu ad 15 mm. longo ut rhachidi gracili; bracteis sub floribus lineari-lanceolatis 1.5–2 mm. longis obscure puberulis glabratis evanescentibus, pedicellis gracilibus sub anthesi 4–9 mm. sub fructu ad 13 mm. longis; floribus sub anthesi 6–8 mm. diametro, sepalis ellipticis vel orbicularibus, exterioribus circiter  $3 \times 2$  mm., interioribus ad 4 mm. longis; petalis nullis; staminibus circiter 60, filamentis sub anthesi circiter 2 mm. longis, antheris ad 1 mm. longis; stylo circiter 1.5 mm. longo, stigmatibus peltatis; fructibus subglobosis vel ellipsoideis  $15\text{--}17 \times 12\text{--}15$  mm., pericarpio 1–2.5 mm. crasso, mesocarpio dense fibroso 0.5–2 mm. crasso, endocarpio crustaceo 0.4–0.8 mm. crasso.

TYPE LOCALITY: Slopes of Mt. Ndelaitho, Ngau, Fiji; the type is *Smith* 7874.

DISTRIBUTION: Endemic to Fiji and known from several of the high islands at elevations of 150–670 m., occurring in dense forest or in the forest-grassland demarcation zone. It has been recorded as a tree 9–21 m. high, sometimes slender, with a trunk to 50 cm. in diameter; the fruit is noted as pale green, becoming nearly white at maturity. Among the available specimens, flowers have been obtained in December and January and fruits between May and July.

LOCAL NAMES AND USE: The generally recorded name is *ndamanu*, but Fijian collectors have also noted *ndamanu ndraulailai* and *ndamanu ndilondilo* on Viti Levu. It is considered a good hardwood timber tree.

Fiji. VITI LEVU: NANDRONGA & NAVOSA: Nausori Highlands, *O. & I. Degener* 32165 (BISH, NY). SERUA: Inland from Ngaloa, *Berry* 111 (BISH, SUVA). NAMOSI: Nambukavesi Creek, *Fiji Dept. For.* 489 (MASS, SUVA). NAITASIRI: Vicinity of upper Navatuvula village, *Fiji Dept. Agr.* 15694 (BISH, SUVA); Prince's Road, *Fiji Dept. Agr.* 142 (A, SUVA, US). RA: Vicinity of Naivotho village, *Damanu* K273 (K, US). OVALAU: Hills west of Lovoni Valley, on ridge south of Mt. Korolevu, *Smith* 7538 (BISH, GH, K, NY, SUVA, UC, US). NGAU: Slopes of Mt. Ndelaitho, on northern spur, toward Navukailangi, alt. 350–500 m., June 22, 1953, *Smith* 7874 (US 2190685 holotype; isotypes at BISH, GH, K, NY, UC). VANUA LEVU: THAKAUNDROVE: Mt. Kasi, *Fiji Dept. Agr.* 15733 (SUVA, US); vicinity of Valeni, *Fiji Dept. Agr.* 15722 (BISH, SUVA); valley of Navonu Creek, *Howard* 104 (BISH, SUVA, US), *Berry* 4 (SUVA). FIJI, without further locality: *G. W. Cottle*, Dec. 1950 (BISH, SUVA).

Unfortunately the only available mature flowers are on the Cottle specimen, without detailed locality, and even those flowers are insect-damaged. Two other specimens, *O. & I. Degener* 32165 and *Fiji Dept. For.* 489,



bear immature inflorescences. However, these three collections adequately permit an understanding of the floral characters. As the type we have preferred to designate a fruiting collection with numerous duplicates. In our area this new species, without petals, is closely related only to *Calophyllum leucocarpum*, differing primarily in the very different and evanescent indument of its young parts; it also has comparatively obvious pedicels, more numerous stamens, and a larger fruit with a thicker endocarp.

3. **Calophyllum inophyllum** L. Sp. Pl. 513. 1753; A. Gray, Bot. U. S. Expl. Exped. 1: 218. 1854; Seem. in Bonplandia 9: 254. 1861, in op. cit. 10: 296. 1862, Viti, 433. 1862, in Jour. Bot. 2: 71. 1864, Fl. Vit. 12. 1865; Horne, A Year in Fiji, 258. 1881; Vesque in DC. Monogr. Phan. 8: 544. 1893; Reinecke in Bot. Jahrb. 25: 656. 1898; Burkill in Jour. Linn. Soc. Bot. 35: 27. 1901; Rechinger in Denkschr. Akad. Wiss. Wien 81: 313. 1910; Guillaumin in Bull. Soc. Bot. France 66: 268. 1919; Setchell in Carnegie Inst. Wash. Publ. 341: 68. 1924; Guillaumin in Bull. Soc. Bot. France 74: 694. 1928, in Jour. Arnold Arb. 12: 227. 1931; Christophersen in Bishop Mus. Bull. 128: 147. 1935; Yuncker in op. cit. 178: 85. 1943, in op. cit. 184: 52. 1945; J. W. Parham in Agr. Jour. Dept. Agr. Fiji 19: 98. 1948, in op. cit. 29: 32. 1959; Yuncker in Bishop Mus. Bull. 220: 187. 1959; J. W. Parham, Pl. Fiji Isl. 134. fig. 52. 1964, ed. 2. 192. fig. 57. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 100. 1970; St. John & A. C. Sm. in Pacific Sci. 25: 326. 1971; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 32. 1972. FIGURES 6-8.

Spreading tree to 25 m. high, often with a massive trunk, glabrous throughout except the young parts and terminal buds minutely but copiously brown-puberulent, the branchlets stout, 3-7 mm. in diameter toward apex; petioles stout, flattened above or canaliculate, 12-30 mm. long; leaf-blades thick-coriaceous, elliptic- to ovate-oblong, 10-23 cm. long, 5-11 cm. broad, obtuse to rounded at base and abruptly decurrent on the petiole, obtuse to rounded or emarginate at apex, rarely subacute, the costa conspicuous, slightly or prominently elevated above and sometimes canaliculate, prominent beneath, the secondary nerves (8-) 10-16 per centimeter, prominulous on both surfaces; inflorescences appearing racemose, rarely paniculate with 1 or 2 short lateral branches, 7-27-flowered, 4-13 cm. long or slightly longer in fruit, the peduncle stout, 3-20 mm. long; flower-subtending bracts papyraceous, broadly ovate, 3-4 × 2-3 mm., rounded at apex, minutely glandular-ciliolate, evanescent, leaving conspicuous transversely oblong scars, the pedicels slender, 10-42 mm. long; flowers 15-30 mm. in diameter at anthesis, the sepals elliptic to suborbicular, broadly obtuse or rounded, the outer ones 6-10 × 5-8 mm., the inner ones 9-15 × 7.5-10 mm.; petals 4 (sometimes stated as 3-5 or even 8), elliptic or obovate, 8-14 mm. long, 5-9 mm. broad, rounded and



entire, often irregularly involute; stamens usually 150–200, the filaments 4–8 mm. long at anthesis, the anthers 1.3–2 mm. long; style conspicuous, 2.5–5 mm. long, the stigma subpeltate, 0.7–1.5 mm. in diameter; fruits drying coriaceous and rugulose, subglobose to subobovoid,  $32\text{--}50 \times 27\text{--}40$  mm., obtuse to rounded at base, the pericarp 2–4 mm. thick, the mesocarp fibrous, 1–3 mm. thick and adhering to the endocarp, this bony, 0.5–1.5 mm. thick; testa of seed with a spongy outer layer 1–12 mm. thick and often conspicuous, the cotyledons oily and dark, not completely filling the locule nor conspicuously compressing the spongy outer layer of the testa.

TYPE LOCALITY: Linnaeus based his species on three prior references, and it is probable that the lectotype should be the plant described in his *Flora Zeylanica*, 201. 1747. We refrain from formally proposing this lectotypification because we lack access to the basic materials that require study, and we may have overlooked some pertinent earlier discussion. However, it is evident that the common Old World species so widespread on beaches is correctly placed under this binomial.

DISTRIBUTION: Eastern Africa and India throughout Malesia and into eastern Polynesia; in Hawaii it is probably a Polynesian introduction that is now thoroughly naturalized. In our area it occurs abundantly on beaches, in coastal thickets or sea-level forests, or along streams near the coast. Its occurrence at elevations of more than a few meters (i.e. near Namosi village in Fiji; on Alofi, Horne Islands; on Ofu, Samoa) doubtless reflects deliberate inland introductions of a useful and ornamental plant. *Calophyllum inophyllum* is a striking and often massive tree, to 25 m. or more in height and with a trunk sometimes 1.5 m. in diameter; its fragrant flowers have white or waxy sepals and petals and yellow anthers; its large fruits, fragrant when ripe, then become yellow to purplish or blackish. In our area it may be found in flower and fruit at all seasons.

LOCAL NAMES AND USES: As one of the best known Pacific trees, this species has quite stabilized local names: *ndilo* (Fiji); *fijau* (Rotuma); *tsilo* or *tilo* (Horne Islands); *fetau* (Wallis Islands, Tonga, Niue, Samoa). In Samoa and possibly in Fiji it sometimes passes as *Alexandrian laurel* or *beach mahogany*. The uses of this beautiful tree are legion, and one can scarcely add to Seemann's 1865 discussion in his "Flora Vitiensis." Its wood is prized for canoe-making and boat-knees, for paddles, house-beams, drums, and bowls. Oil expressed from the fragrant fruits is used extensively as a medicinal liniment and to scent coconut oil; and an infusion of the leaves is used for medicinal purposes ranging from eye-washes to cures for chicken pox.

New Hebrides. VANUA LAVA, Banks Group: *Kajewski* 431 (A, NY). TANA: Port Resolution, *Kajewski* 69 (A, NY). ANEITYUM: Anelgauhat Bay, *Kajewski* 783 (A, BISH, K, NY, US).

Fiji. YASAWAS: WAYA: Yalombi, *St. John* 18903 (BISH). MAMANUTHAS: MALOLO GROUP: Nggalito Island, O. & I. *Degener* 32219 (BISH, NY). VITI LEVU: MBA: Lautoka, *Greenwood* 351 (K). NANDRONGA & NAVOSA: Vatukarasa,



*Fiji Dept. Agr.* 9287 (*McKee* 2857) (BISH, SUVA). SERUA: Namboutini, *Fiji Dept. For.* 969 (SUVA); Korovisilou, *Fiji Dept. For.* 281 (*Damanu* 9) (K, SUVA); Vunimanggo, *Fiji Dept. For.* 914 (SUVA); Ndeumba, *Fiji Dept. Agr.* 12461 (SUVA); Navua, *Livingston*, in 1945 (US), *Fiji Dept. For.* 989 (SUVA). NAMOSI: Waindina valley near Namosi village, *Gillespie* 2811 (A, BISH, UC). RA: Waindawa, near Vaileka, *Degener* 15420 (A, BISH, K, NY, UC, US); Ellington, *Parks* 20853 (BISH, UC). TAILEVU: *Fiji Dept. Agr.* 13591 (SUVA); Matavatathou, *Fiji Dept. Agr.* 9231 (SUVA); Nausori, *Fiji Dept. Agr.* 141 (A, SUVA). NAITASIRI: Vunindawa, *Fiji Dept. Agr.* 10011 (SUVA). REWA: Suva, *Meebold* 16426 (SUVA). KANDAVU: Namalata Isthmus region, *Smith* 177 (BISH, GH, K, NY, UC, US). OVALAU: *Graeffe* (NY); Thawathi, *Smith* 8101 (BISH, GH, K, NY, SUVA, UC, US); Levuka, *Degener & Ordonez* 13786 (A, NY). KORO: Nambosovi, *Fiji Dept. Agr.* 1033 (SUVA). NAIRAI: *Milne*, Nov. 1855 (K). NGAU: Shore of Herald Bay, near Sawaieke, *Smith* 7944 (BISH, GH, K, NY, SUVA, UC, US). VANUA LEVU: MATHUATA: Nakuthi Island, *Fiji Dept. Agr.* 15279 (BISH, SUVA). THAKAUNDROVE: Ndawara, lower Yanawai River, *Fiji Dept. Agr.* 15737 (SUVA); west of Valethi, *Bierhorst* F114 (MASS); east of Savusavu, *Bierhorst* F187 (MASS); Korotasere, *Fiji Dept. Agr.*, Nov. 26, 1949 (SUVA). "TAVEUNI and LAKEMBA": *Seemann* 48 (BM, GH, K). TAVEUNI: Nggeleni Road, *Fiji Dept. Agr.* 15873 (SUVA); Waiyevo, *Gillespie* 4633 (BISH). YATHATA: Navakathuru, *Fiji Dept. Agr.* 15557 (SUVA), 16197 (MASS, SUVA). VANUA MBALAVU: Lomaloma, *Fiji Dept. Agr.* 10206 (SUVA). NAVUTU-I-LOMA: *Bryan* 463 (A, UC, US). FIJI, without further locality: *U. S. Expl. Exped.* (GH, NY), *Storck* 873 (BM), *Howard* 31 (SUVA).

Horne Islands. FUTUNA: *Burrows* 14 (BISH). ALOFI: Mt. Vaisei, *Yen* X58 (BISH).

Wallis Islands. UVEA: *Graeffe* 33 (BM), *Burrows* W16 (BISH).

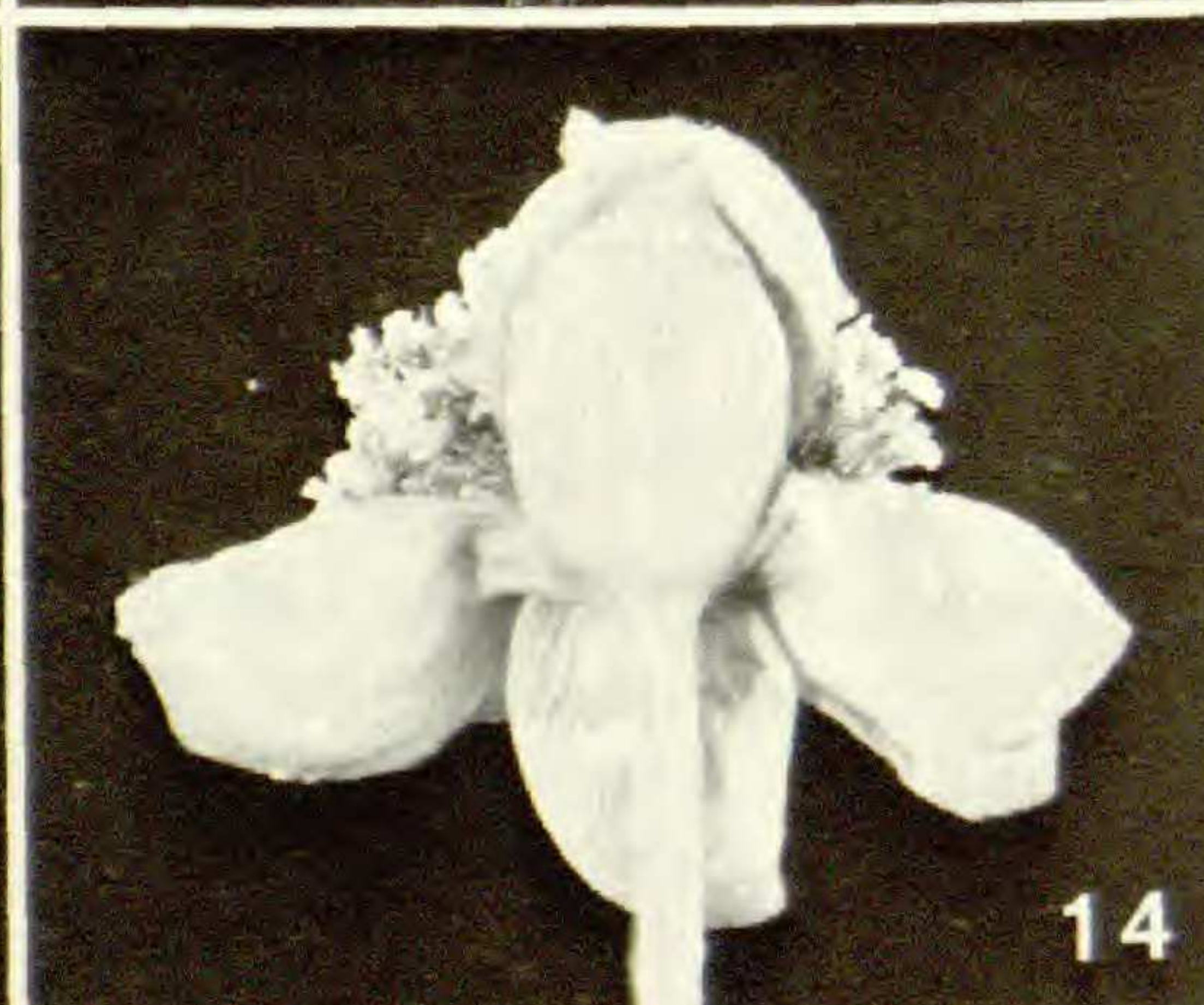
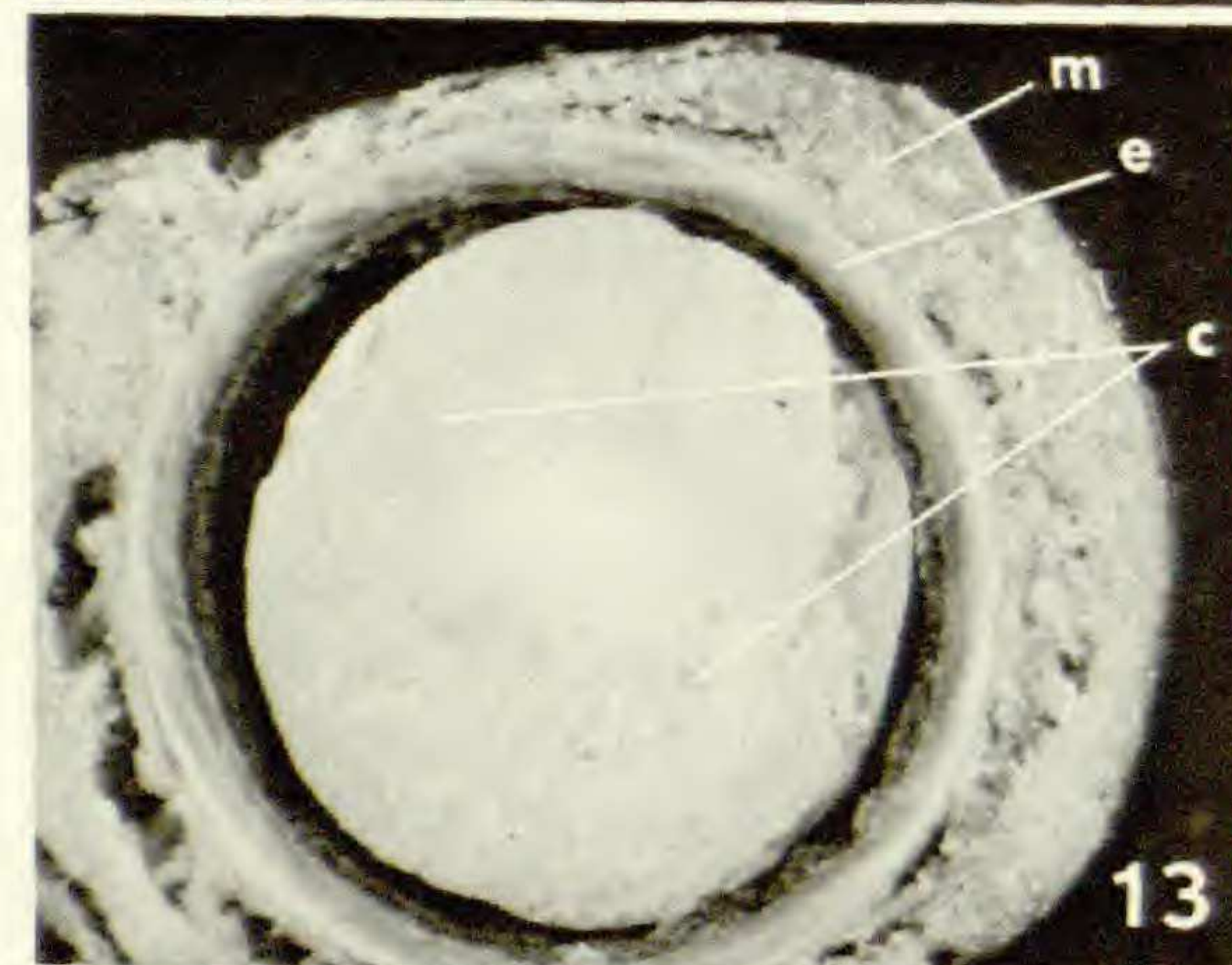
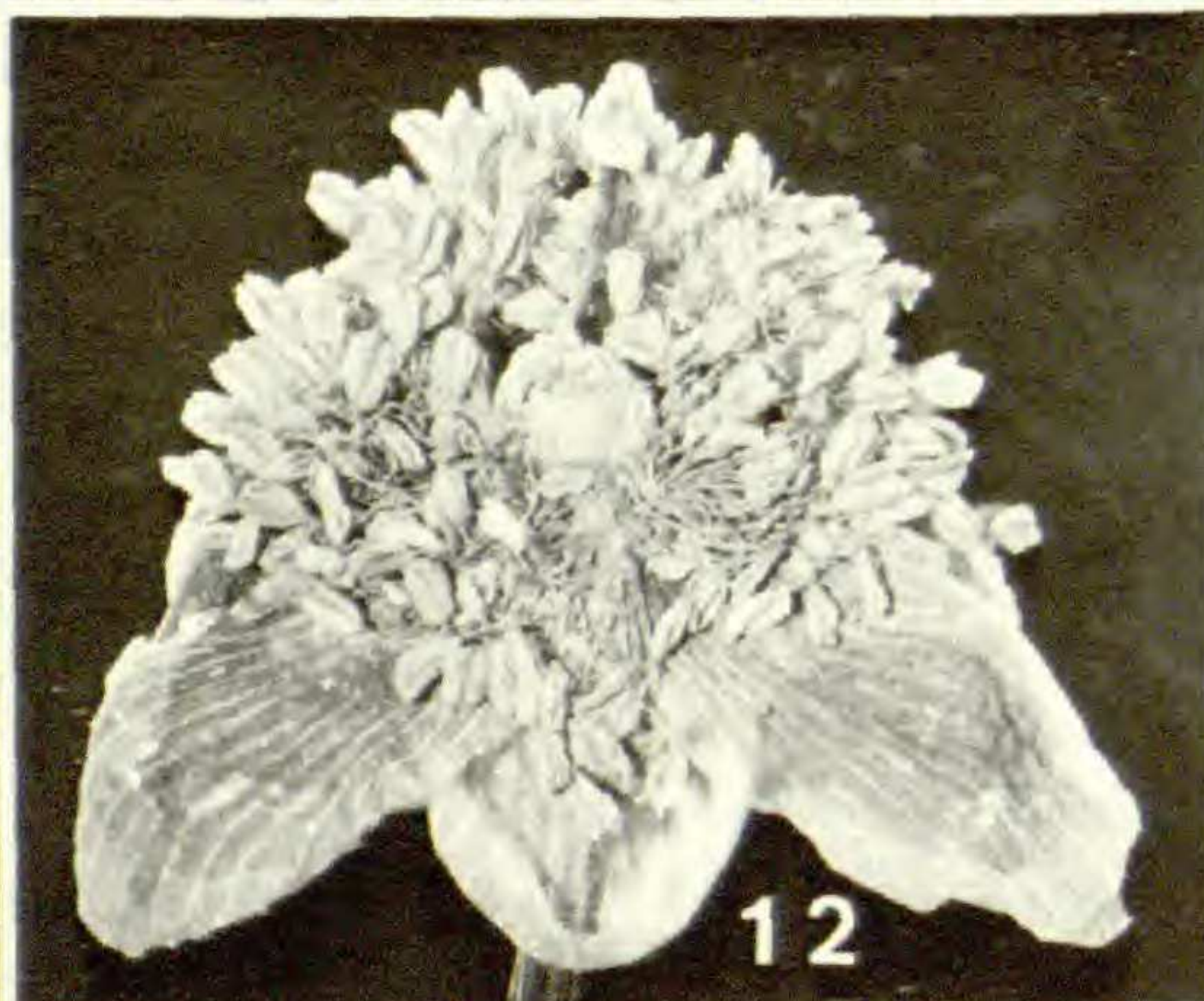
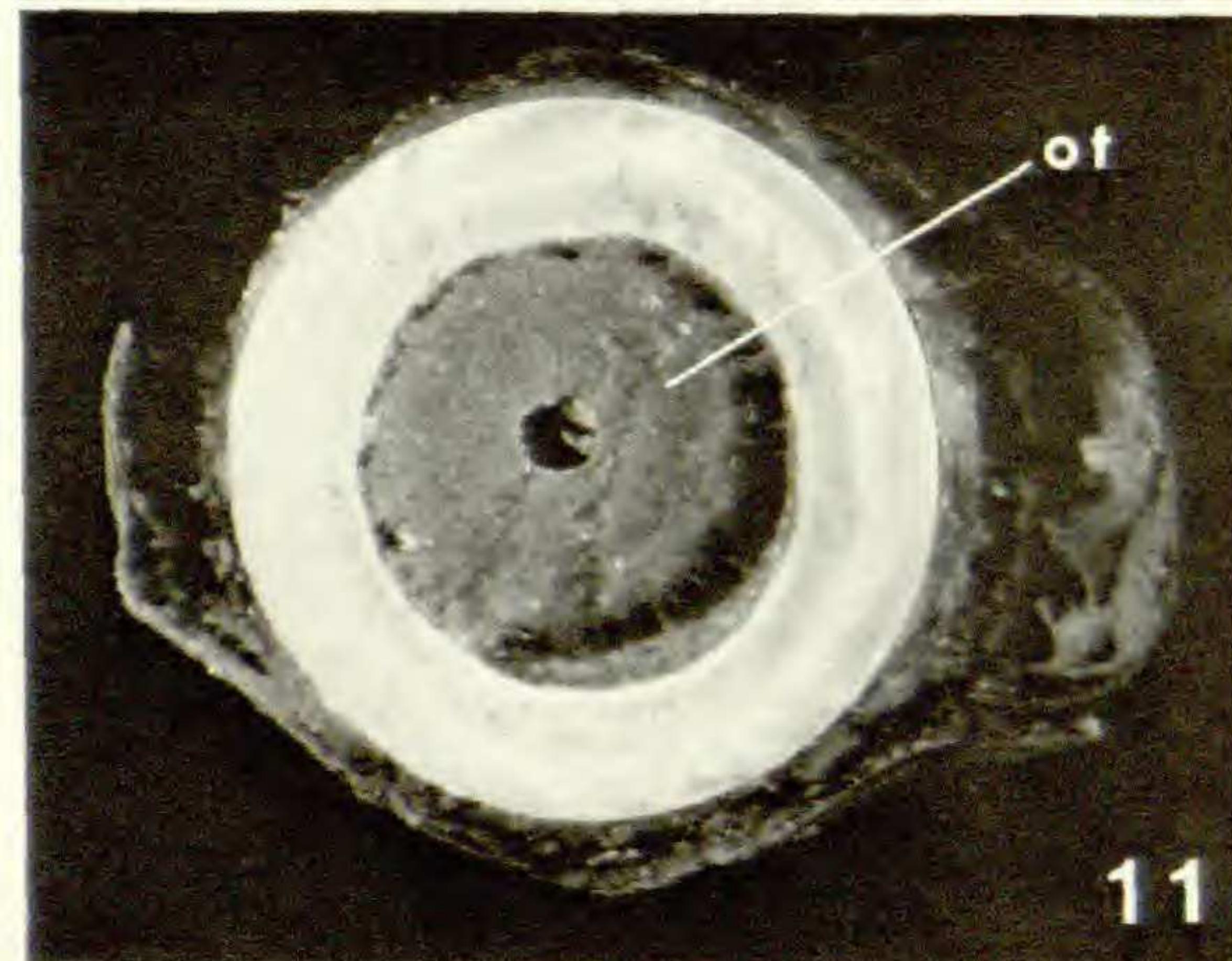
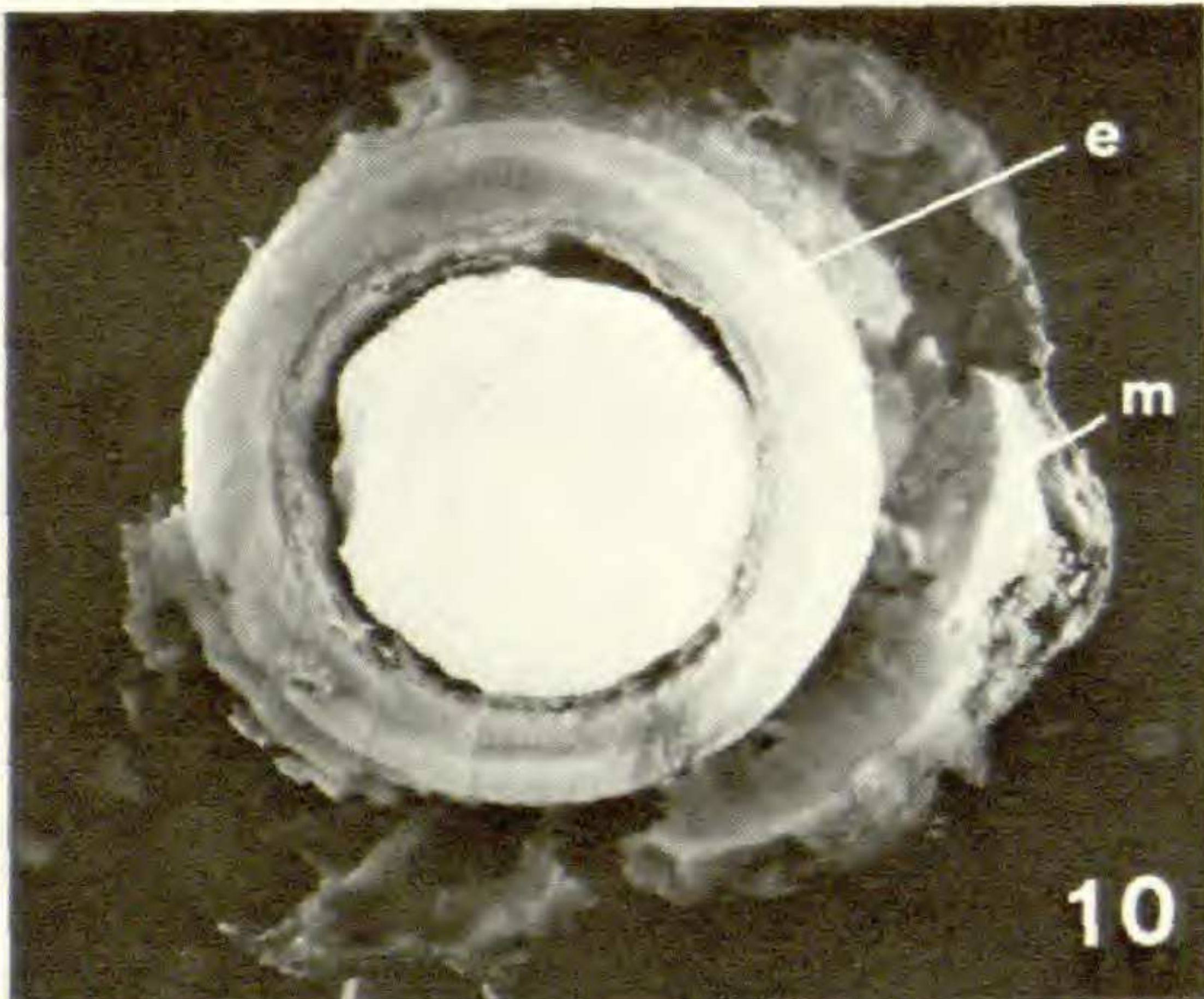
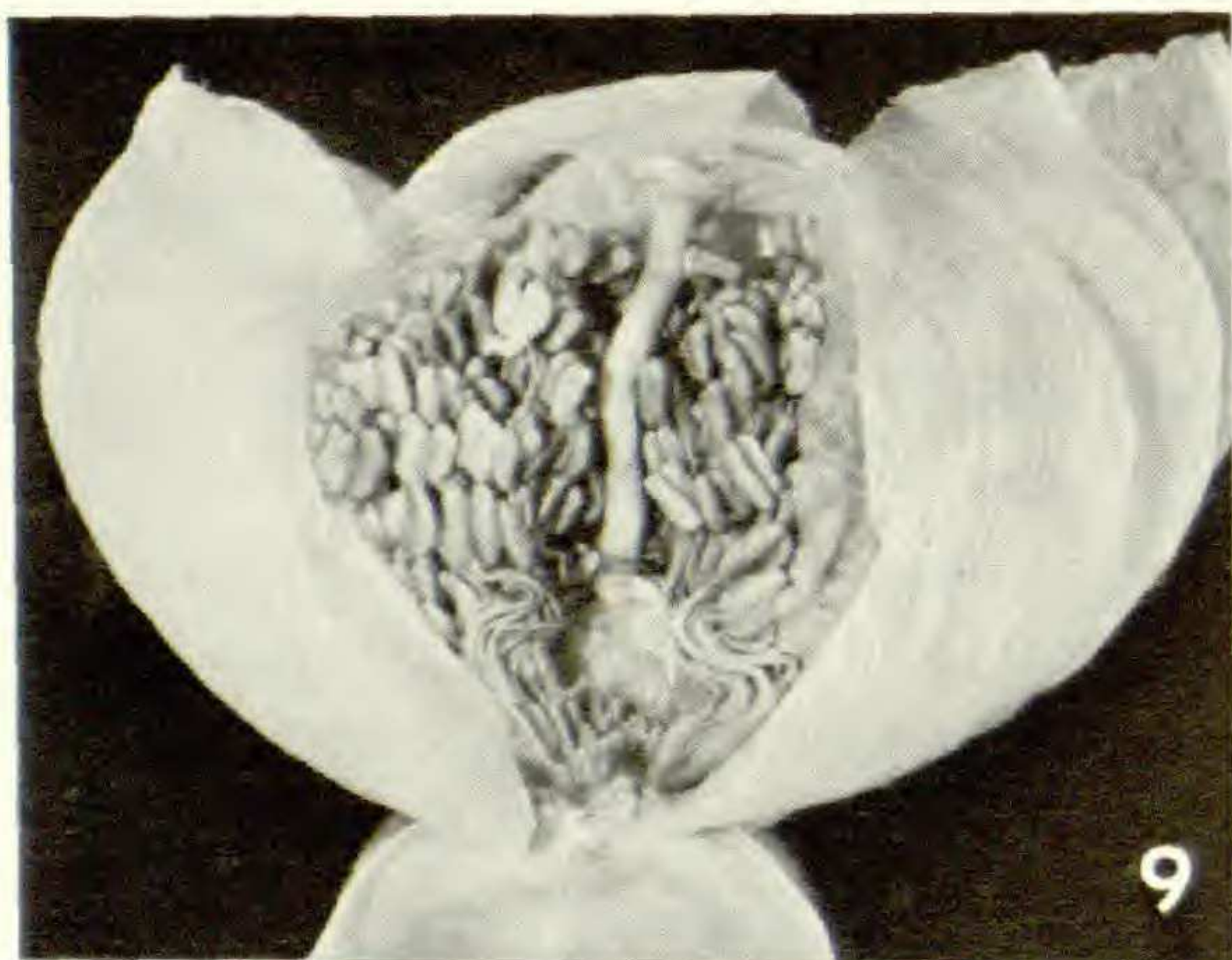
Tonga. LIFUKA: Toward southern end of island, *Yuncker* 15792 (BISH, BM, US). TONGATAPU: Ha'avakatolo, *Setchell & Parks* 15595 (UC); Sopo, *Yuncker* 15024 (BISH, BM, GH, US); Nuku'alofa, *Soakai* 476 (BISH, K); Hihifo, *Setchell & Parks* 15515 (UC); Kolonga Point, *Setchell & Parks* 15387 (UC). 'EUA: *Moore* 427 (US); Ohonua, *Parks* 16383 (BISH, UC), *Yuncker* 15638 (BISH, BM, GH, US). TONGA, without further locality: *Cook's 3rd Voyage* (BM), *McKern* 37 (BISH).

Niue. Near Alofi, *Yuncker* 9738 (A, BISH, UC), 10059 (BISH, UC, US), *Sykes* 353 (BISH).

Samoa. SAVAI: Asau Harbor, *Hocking*, Nov. 24, 1968 (BISH), *Walker*, Dec. 27, 1968 (BISH); Matautu Bay, *Reinecke* 506a (BISH); Lelepa, *Christophersen & Hume* 1941 (BISH); Sale'aula, *Bristol* 2347 (BISH); between Salailua and Lataitai, *Christophersen* 2870 (BISH, NY). UPOLU: Leulumoega, *Rechinger* 571 (BM, US); between Mata'utu and Salamumu, *Bristol* 2368 (BISH). TUTUILA: Pago Pago, *Setchell* 99 (UC); Fagatoga, *Wisner* 111 (BISH). OFU: On ridge back of Ofu village, *Yuncker* 9468 (BISH). TAU: Luma, *Garber* 704 (BISH, UC); Siufaga, *Yuncker* 9194 (BISH). SAMOA, without further locality: *Whitmee* (GH).

*Calophyllum inophyllum* is readily distinguished from the other species of our area in being a tree of the seashore (unless introduced inland), in its large, comparatively broad, and characteristically rounded leaf-blades, and in its large flowers and fruits, the latter with the outer integument of the seed spongy and very thick even when the cotyledons are fully developed. This last characteristic gives the fruits great buoyancy and permits them to become established along the strand.







4. *Calophyllum vitiense* Turrill in Jour. Linn. Soc. Bot. 43: 17. 1915; Watkins in Agr. Jour. Dept. Agr. Fiji 31: 15. fig. 1961; J. W. Parham, Pl. Fiji Isl. 134. 1964, ed. 2. 192. 1972. FIGURES 9-11.

*Calophyllum spectabile* sensu A. Gray, Bot. U. S. Expl. Exped. 1: 218, p. p. 1854, in Proc. Am. Acad. Arts 5: 315. 1862, in Bonplandia 10: 34. 1862; Seem. Fl. Vit. 11. 1865; Horne, A Year in Fiji, 258. 1881; non Willd.

*Calophyllum polyanthum* sensu Seem. in Bonplandia 9: 254. 1861, Viti, 433. 1862; non Wall.

*Calophyllum lanceolatum* sensu Seem. Viti, 433. 1862; non auct.

Tree to 30 m. high, glabrous throughout except the young parts and terminal buds copiously but minutely ferruginous-tomentellous-puberulent, the branchlets stout, 2-5 mm. in diameter toward apex; petioles stout, semiterete or canaliculate, (5-) 15-35 mm. long; leaf-blades coriaceous, lanceolate or narrowly elliptic, (7-) 13-30 cm. long, (2-) 3-7.5 cm. broad, acute to attenuate at base and long-decurrent on the petiole, acuminate to acute at apex (tip to 10 mm. long, rounded or obtuse), rarely subobtusate, the costa plane or slightly raised above and often shallowly canaliculate, prominent beneath, the secondary nerves (8-) 11-20 (-24) per centimeter, prominulous on both surfaces; inflorescences appearing long-racemose, infrequently reduced, (3-) 7-15-flowered, (2-) 8-14 cm. long or slightly longer in fruit, the peduncle (0.5-) 1-6 cm. long, with the rachis and pedicels very obscurely puberulent but soon glabrate; flower-subtending bracts oblong-lanceolate, 5-7 mm. long, about 2 mm. broad, soon caducous, the pedicels slender, terete, 9-30 (-35) mm. long; flowers 20-23 mm. in diameter at anthesis, the sepals orbicular to obovate, conspicuously nerved, the outer ones 7-10 mm. in diameter, the inner ones 12-15  $\times$  10-12 mm.; petals 4, papyraceous, elliptic, 9-16 mm. long, 7-10 mm. broad, rounded and often obscurely erosulous distally, nerved like the sepals; stamens about 200, the filaments 3-7 mm. long at anthesis, the anthers 0.9-1.2 mm. long; style conspicuous, 3-6 mm. long, the stigma peltate, about 1.5 mm. in diameter; fruits ellipsoid or subglobose, 22-30  $\times$  15-26 mm., the pericarp 4-9 mm. thick, the mesocarp fibrous-spongy, greatly shrinking or collapsing in drying, 2-5.5 mm. thick, the endocarp bony, (1.8-) 2-3.5 mm. thick; testa of seed with a fibrous outer layer, this at first (and in sterile fruits) 2-4 mm. thick, usually compressed to 0.2-0.6 mm. thick by the developing cotyledons.

TYPE LOCALITY: Turrill cited two collections, *Seemann* 47 and *im Thurn* 297; although the two are certainly conspecific, the first is sterile,

FIGURES 9-11. *Calophyllum vitiense*: 9 from *Smith* 6362, 10 from *Greenwood* 907, 11 from *Howard* 187. 9, flower, with one petal and a few stamens removed,  $\times$  3; 10, cross section of fruit, the outer layer of the testa compressed by the developing cotyledons,  $\times$  2; 11, cross section of sterile fruit without cotyledons, the outer layer of the testa thickened,  $\times$  2. FIGURES 12, 13. *Calophyllum samoense*: 12 from *Christophersen* 720, 13 from *Bristol* 2248. 12, open flower,  $\times$  3; 13, cross section of fruit,  $\times$  2. FIGURES 14-16. *Calophyllum neobudicum*: 14 and 15 from *Kajewski* 705, 16 from *Kajewski* 399. 14, proximal surface of flower,  $\times$  3; 15, open flower,  $\times$  3; 16, cross section of fruit,  $\times$  2. m = mesocarp; e = endocarp; ot = outer layer of testa; c = cotyledons.



and obviously the second was the principal basis of the original description. We therefore designate as the lectotype the three complementary sheets (at Kew) of *im Thurn* 297, from the vicinity of Nandarivatu, Mba Province, Viti Levu, Fiji.

**DISTRIBUTION:** Endemic to Fiji and known from several of the high islands at elevations of 100–950 m., occurring in dense forest as a tree 5–30 m. high and with a trunk diameter up to (and doubtless exceeding) 50 cm. The sepals, petals, filaments, and style are white; the anthers are yellow; the fruit is at first green but when mature becomes dark purple. Flowers have been noted between October and January, but fruits seem to persist throughout the year.

**LOCAL NAMES AND USES:** In addition to *ndamanu* (used by Fijians for any inland species of the genus), the name *ndamanu ndilondilo* has been noted. Foresters and timber-cutters in Fiji do not differentiate among the forest species of *Calophyllum*, considering any tree of *ndamanu*, if sufficiently large, to produce a valuable and durable timber suitable for general construction, furniture, etc.

Fiji. VITI LEVU: MBA: Mountains near Lautoka, *Greenwood* 907 (A); Mt. Evans Range, *Greenwood* 1232 (US); vicinity of Nandarivatu, Dec. 2, 1906, *im Thurn* 297 (K lectotype; isoelectotype at BM), *Tothill* 24 (K), *Mead* 1972 (K), *Gillespie* 4003 (UC), 4055 (BISH, GH, UC), 4229 (A, BISH, GH, NY, UC, US), *Vaughan* 3431 (BM, K). NAMOSI: *Fiji Dept. Agr.* 14236 (A, NY, SUVA). TAILEVU: Hills east of Wainimbuka River, near Ndakuivuna, *Smith* 7201 (BISH, GH, K, NY, SUVA, UC, US). NAITASIRI: Wainiveimbambala Creek, *Fiji Dept. Agr.* 5833 (BISH, SUVA); Tholo-i-suva, *Fiji Dept. Agr.* 12448 (*Watkins* 751) (K, MASS, SUVA); Tamavua, *Gillespie* 2407 (BISH, GH, NY, UC, US); Kalambo, *Fiji Dept. Agr.* 16410 (BISH, MASS, SUVA), 16411 (SUVA); Nasinu, *Gillespie* 3647 (BISH, UC). VITI LEVU, without further locality: *M'Gillivray* 38 (K), *M'Gillivray & Milne* 67 (K), *Seemann* 47 (GH, K). OVALAU: *Graeffe* (NY); Mt. Korotolutolu, west of Thawathi, *Smith* 8021 (BISH, GH, K, NY, SUVA, UC, US); west of Lovoni valley, on ridge south of Mt. Korolevu, *Smith* 7542 (BISH, GH, K, NY, SUVA, UC, US); hills east of Lovoni valley, *Smith* 7269 (BISH, GH, K, NY, SUVA, UC, US). KORO: Main ridge, *Smith* 1047 (BISH, GH, K, NY, UC, US). VANUA LEVU: MATHUATA: Vicinity of Lambasa, *Greenwood* 507 (K), 515 (K); Mt. Numbuiloa, east of Lambasa, *Smith* 6362 (A, K, US). VANUA LEVU, without further locality: *Milne* 244 (K), *Howard* 187 (SUVA, US). FIJI, without further locality: *U. S. Expl. Exped.* (GH), *Horne* 192 (GH).

Among the inland species of our area with 4 petals, *Calophyllum vitiense* is readily distinguished by its large and comparatively narrow leaf-blades and its elongate inflorescences with large flowers. Its fruits characteristically have a fibrous-spongy mesocarp that shrinks or collapses in drying; *C. samoense*, which occurs in the Lau Group of Fiji, has a similar mesocarp but there the endocarp is seldom more than 1 mm. thick, whereas the endocarp of the fruits of *C. vitiense* is usually 2–3.5 mm. thick, more solid and durable than those of any other *Calophyllum* of the Fijian Region.

In our present opinion *Calophyllum vitiense* is endemic to the high is-



lands of Fiji. References to its occurrence in the Solomon and Santa Cruz Islands (Smith, 1941: 347; Whitmore, 1966: 78; 1967: 12) seem unwarranted, in view of the superficial similarities among forest *Calophylla* of different southwestern Pacific archipelagoes and their presumably independent origins from coastal species. *Calophyllum vitiense* has also been mentioned as occurring in Samoa and Tonga and on Niue; such usages are cited in the synonymies to follow.

5. *Calophyllum samoense* Christophersen in Bishop Mus. Bull. 128: 147. fig. 20. 1935; Yuncker in Bishop Mus. Bull. 184: 52. 1943; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Info. Ser. 85: 121. 1972. FIGURES 12, 13.

*Calophyllum spectabile* sensu Reinecke in Bot. Jahrb. 25: 656. 1898; Rechinger in Denkschr. Akad. Wiss. Wien 81: 313. 1910; non Willd.

*Calophyllum vitiense* sensu Setchell in Carnegie Inst. Wash. Publ. 341: 69. 1924; non Turrill.

*Calophyllum neo-ebudicum* sensu St. John & A. C. Sm. in Pacific Sci. 25: 326. 1971; non Guillaumin.

Tree to 25 m. high, glabrous throughout except the young parts and terminal buds copiously but minutely ferruginous-tomentellous-puberulent, the branchlets 1.5–3.5 mm. in diameter toward apex; petioles slender, semiterete or shallowly canaliculate, 10–25 mm. long; leaf-blades subcoriaceous, ovate- to oblong-elliptic, (4–) 6.5–17 cm. long, (1.5–) 2–7 cm. broad, attenuate to acute at base and long-decurrent on the petiole, obtuse to obtusely cuspidate or short-acuminate at apex (tip to 7 mm. long), the costa nearly plane but shallowly canaliculate above, prominent beneath, the secondary nerves 14–30 per centimeter, prominulous on both sides; inflorescences pseudo-racemose, 7–13-flowered, (2.5–) 5–11 cm. long, the peduncle (0.5–) 1–3.3 cm. long, slender like the rachis; pedicels slender, terete, (8–) 10–22 mm. long; flowers 13–16 mm. in diameter at anthesis, the sepals orbicular to elliptic, rounded and often involute, the outer ones 4.5–8 × 4–7 mm., the inner ones 5.5–10.5 × 4–5.5 mm.; petals 4, obovate-elliptic, 5–11 mm. long, 3.5–5 mm. broad, rounded and sometimes inconspicuously erosulous distally; stamens about 150, the filaments (1–) 3–4.5 mm. long at anthesis, the anthers 0.8–1.1 mm. long; style 2–3 mm. long at anthesis, the stigma peltate, 0.8–1 mm. in diameter; fruits ovoid or subglobose, (22–) 25–30 × (20–) 23–30 mm., the pericarp 4–7 mm. thick at maturity, the mesocarp fibrous-spongy, 3.5–6 mm. thick, the endocarp 0.5–1.2 mm. thick; testa of seed with a fibrous outer layer, this compressed by the developing cotyledons and at maturity not exceeding 1 mm. thick.

TYPE LOCALITY: Between Vaipouli and Manase, Savaii, Samoa; the type is *Christophersen* 720.

DISTRIBUTION: Samoa, and also occurring in the Horne Islands and in the Lau Group of Fiji. It has been obtained at elevations close to sea-level and up to 650 m. in dry or humid forest or in secondary forest,



often growing on limestone. Collectors indicate it as a tree 5–25 m. high, with a trunk diameter of up to 60 cm.; the sepals and petals are white; and the fruits at maturity become purple or black. Flowers have been obtained between September and December, but fruits persist through much of the year.

LOCAL NAMES AND USES: In Samoa and the Horne Islands *tamanu* is commonly used; in Samoa *malili* has also been noted, and on Moala, Fiji, *ndamanu kula*. The timber is used for canoes, house-building, and bowls in both Samoa and the Horne Islands; no such uses were recorded in Lau, although practically any hardwood of this size is prized in Fiji.

Fiji. MOALA: *Bryan*, July 11, 1924 (BISH); near Maloku, *Smith* 1334 (BISH, GH, K, NY, UC, US). NAITAMBA: *Fiji Dept. For. L.12384* (BISH). MANGO: On limestone, *Bryan* 569 (A, BISH).

Horne Islands. FUTUNA: Upland forests, *Burrows* 18 (BISH); slopes south of Mt. Puke, *McKee* 19850 (P). ALOFI: On limestone, *McKee* 19810 (BISH, P).

Samoa. SAVAI: Neiafu, *Bristol* 2209 (BISH); vicinity of Manase, *Vaupel* 214 (BISH, K, NY, US), *Christophersen & Hume* 2417 (BISH, NY, UC); between Vaipouli and Manase, alt. 100 m., Sept. 21, 1929, *Christophersen* 720 (BISH holotype; isotypes at A, BISH, K, UC, US); inland from Vaipouli, *Christophersen & Hume* 1916 (BISH, NY, UC, US); Matavanu lava field, *Christophersen & Hume* 1871 (A, BISH); Salailua, *Christophersen* 2991 (A, BISH, NY, UC, US); inland from Gataivai, *Bristol* 2248 (BISH, GH). UPOLU: Inland from Apia, *Reinecke* 204 (BISH); ridge above and vicinity of Malololelei, *Christophersen* 162a (BISH), 305 (BISH, US). TUTUILA: Trail to Vatia, *Setchell* 334 (BISH, UC); Aua-Aofono Pass, *Setchell* 221 (UC). SAMOA, without further locality: *Whitmee* 9 (K), *Powell* 335 (K).

Although the *Calophylla* of our area with 4 petals are confusingly similar when sterile, we believe that the present taxon cannot be referred to either *C. vitiense* or *C. neo-ebudicum*. It differs from the former in its differently proportioned leaf-blades and its smaller flowers, and most markedly in the comparatively thin endocarp of its fruits. From *C. neo-ebudicum* it is less readily separated in floral characters, but its fruits are quite different; those of the New Hebridean species are definitely longer than broad and have a firmly fibrous mesocarp 1–4 mm. thick that does not fall away from the endocarp and leave air-cavities, as does the thicker, spongy mesocarp of *C. samoense*. Proportions of the leaf-blades of the two taxa also differ slightly. Dr. M. Corbasson, of the Centre Technique Forestier Tropical in Noumea, on the basis of his field observation points out to us (in litt.) that the two taxa differ in their habit, general aspect, bark, wood, and even habitat; although zones of coralline limestone occur in the New Hebrides, they are not occupied by *C. neo-ebudicum*. The comparatively broad distribution of *C. samoense* may be due to the buoyancy of its fruits in sea water imparted by their spongy mesocarp.

6. *Calophyllum neo-ebudicum* Guillaumin in Jour. Arnold Arb. 12: 227. 1931. FIGURES 14–16.

*Calophyllum inophyllum* ? Guillaumin in Jour. Arnold Arb. 12: 227. 1931.



Tree to 30 m. high, glabrous throughout except for the obscurely puberulent young parts and terminal buds, the branchlets slender, 1.7–2 mm. in diameter toward apex; petioles slender, semiterete or shallowly canaliculate, (12–) 14–25 mm. long; leaf-blades subcoriaceous, elliptic-lanceolate or narrowly ovate-oblong, (3.5–) 5–10 cm. long, (1.5–) 2.3–4.2 cm. broad, attenuate to acute at base and long-decurrent on the petiole, obtuse to obtusely cuspidate at apex (tip rarely as much as 5 mm. long), the costa slightly raised above and shallowly canaliculate, sharply raised beneath, the secondary nerves 15–30 per centimeter, slightly prominulous on both sides; inflorescences pseudo-racemose, (3–) 7–13-flowered, (2.5–) 5–7 cm. long, the peduncle 1–3 cm. long, slender like the rachis; pedicels slender, 10–25 mm. long; flowers 10–16 mm. in diameter at anthesis, the sepals orbicular to elliptic, the outer ones 5.5–7 (–7.5)  $\times$  4–6 mm., the inner ones 5.5–7.5 (–9)  $\times$  5–7 mm.; petals 4, elliptic or obovate, 6.5–8 (–11) mm. long, 3–4.5 mm. broad, rounded and often involute; stamens 150–225, the filaments 3–4 (–4.5) mm. long at anthesis, the anthers 0.6–0.9 mm. long; style 2–2.5 mm. long at anthesis, the stigma peltate or shallowly infundibular, 0.7–1 mm. in diameter; fruits obovoid or ellipsoid, 17–35  $\times$  13–28 mm., the pericarp 2–5 mm. thick at maturity, the mesocarp firmly fibrous, adhering to the endocarp, not spongy, 1–4 mm. thick, the endocarp 0.4–1 mm. thick; testa of seed with an outer layer compressed by the developing cotyledons at maturity and less than 1.5 mm. thick.

TYPE LOCALITY: Anelgauhat Bay, Aneityum, New Hebrides; as the lectotype we herewith designate *Kajewski* 705. In describing this species Guillaumin cited three of Kajewski's collections, nos. 288 and 399 from Eromanga as well as no. 705. The only flowering specimen of the three seems the most appropriate lectotype.

DISTRIBUTION: Apparently endemic to the Santa Cruz Islands and the New Hebrides, where it occurs at elevations of 25–300 m. in dense or disturbed forest, as a tree 20–30 m. high with a trunk diameter up to 1 m. The sepals and petals are white and the anthers yellow; the fruit becomes brown or blackish at maturity. Flowers have been collected in November and February, and fruits between May and September.

LOCAL NAMES AND USES: Kajewski has noted the names *keoli* (Vanikoro), *pork-cull* or *porkgudi* (Eromanga), and *inpece* (Aneityum). The species produces light, strong wood that is locally used for canoe-building and for spears; the timber is also a valuable export. The tree is said to be one of the largest and most common trees of the New Hebrides forest.

Santa Cruz Islands. VANIKORO: *Kajewski* 642 (A, UC, US).

New Hebrides. EROMANGA: Dillon Bay, *Kajewski* 288 (A, NY), 399 (A, BISH, K, NY); South River watershed, *Johnson* 13 (A, K). ANEITYUM: Anelgauhat Bay, alt. 25 m., Feb. 4, 1929, *Kajewski* 705 (A lectotype; isoelectotypes at BISH, K, NY, P, US), *Wilson* (in *Kajewski*) 953 (A, BISH, NY, US).

Among described species, *Calophyllum neo-ebudicum* seems suggestive only of *C. samoense*. As discussed above under the latter species, the two



taxa have quite different fruits; they have probably evolved independently from coastal forbears. Whitmore (1967: 14) cites *Kajewski* 705 (K) as an isotype without explanation, but this can scarcely be considered adequate lectotypification; he also mentions *Kajewski* 642 as intermediate between *C. neo-ebudicum* and *C. paludosum* C. T. White, although to us it appears entirely typical of the former. The reference of other collections from the Santa Cruz Islands (Whitmore, 1967: 13) to *C. vitiense* should be examined with *C. neo-ebudicum* in mind.

7. *Calophyllum amblyphyllum* A. C. Sm. & S. Darwin, sp. nov.

FIGURES 17–19.

*Calophyllum* sp. n. Horne, A Year in Fiji, 258. 1881.

*Calophyllum spectabile* sensu Hemsl. in Jour. Linn. Soc. Bot. 30: 169. 1894; non Willd.

*Calophyllum* sp. Burkill in Jour. Linn. Soc. Bot. 35: 27. 1901.

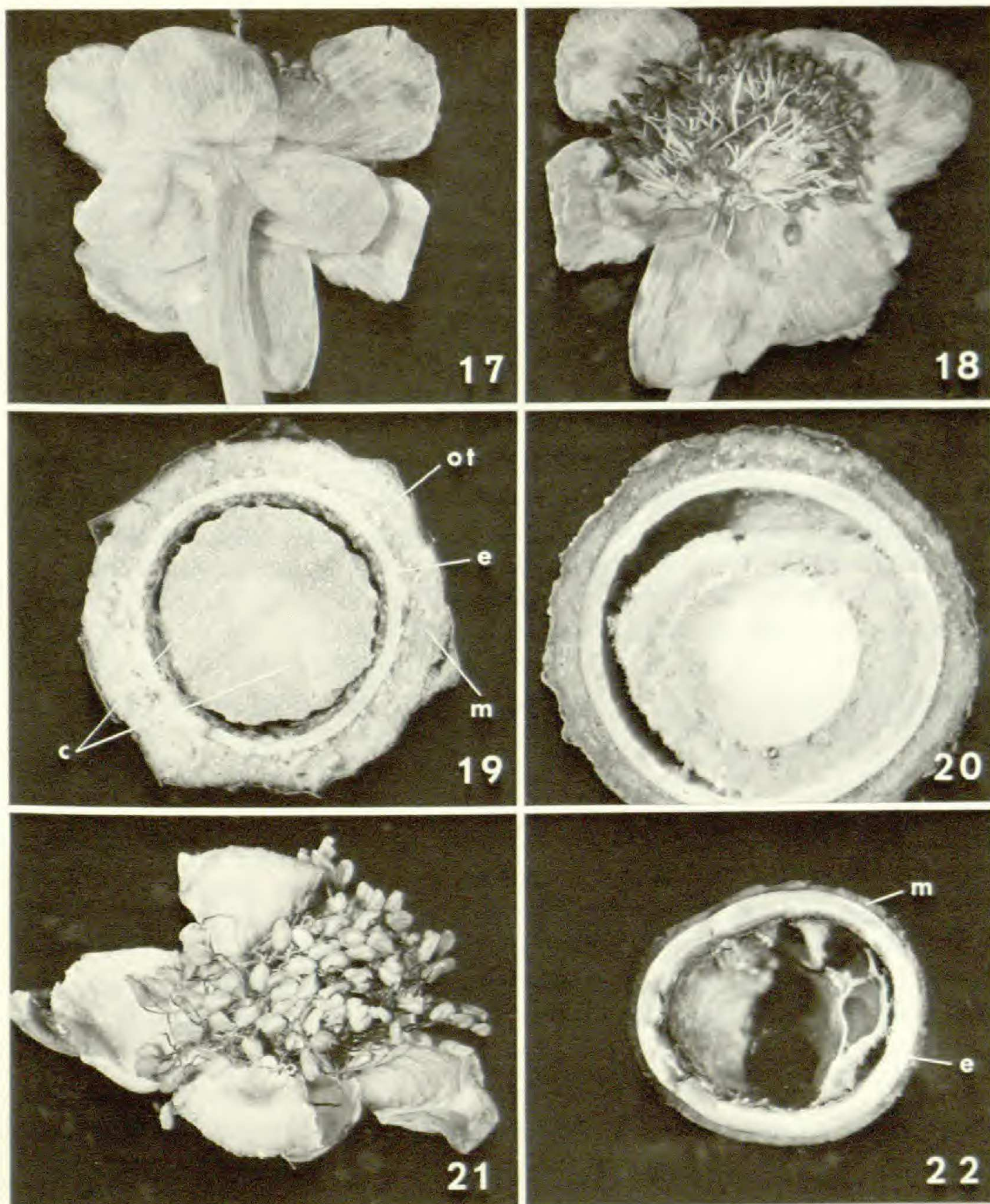
*Calophyllum vitiense* sensu Yuncker in Bishop Mus. Bull. 220: 188. 1959; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 100. fig. 9. 1970; non Turrill.

*Calophyllum neo-ebudicum* sensu J. W. Parham, Pl. Fiji Isl. ed. 2. 192, p. p. 1972; non Guillaumin.

Arbor ad 25 m. alta partibus juvenilibus et gemma terminali copiose sed minute ferrugineo-puberulis mox glabratis, ramulis comparate robustis apicem versus 2–4.5 (–7) mm. diametro; petiolis crassis semiteretibus vel leviter canaliculatis 6–35 mm. longis; foliorum laminis coriaceis ellipticis vel ovato-ellipticis vel lanceolatis, (5–) 6–17 (–25) cm. longis, (1.5–) 2–5.5 (–8) cm. latis, basi acutis vel obtusis et in petiolum decurrentibus, apice obtusis vel rotundatis interdum obtuse brevi-cuspidatis, margine anguste recurvatis vel interdum manifeste revolutis, costa supra leviter vel peracute canaliculata subtus prominenti, nervis secundariis 12–30 (–50) per centimetrum utrinque prominulis vel supra subplanis; inflorescentiis fide racemosis (3–) 5–13-floris sub anthesi 3–7 cm. et interdum sub fructu ad 17 cm. longis, pedunculo 0.2–3 (–7) cm. longo; pedicellis gracilibus sub anthesi (5–) 8–20 mm. et interdum sub fructu ad 45 mm. longis; floribus sub anthesi 12–18 mm. diametro, sepalis suborbicularibus vel ellipticis, exterioribus 5–8 × 5–7.5 mm., interioribus 6–9.5 × 4.5–7.5 mm., saepe anguste involutis; petalis 4 ellipticis 6–10 mm. longis 3–6.5 mm. latis integris vel obscure erosulis; staminibus 150–200, filamentis sub anthesi 2–6 mm. longis, antheris 0.7–1.1 mm. longis; stylo sub anthesi circiter 2 mm. longo, stigmate peltato 0.6–1.2 mm. diametro; fructibus ellipsoideis vel subglobosis 18–40 × 15–30 mm., in sicco coriaceis, pericarpio maturitate 1.5–5 mm. crasso, mesocarpio dense fibroso compacto non spongioso ad endocarpium adhaerenti 1–4 mm. crasso, endocarpio osseo 0.5–1.5 mm. crasso; testae seminis strato externo cotyledonibus evolutis compresso maturitate raro plus quam 2 mm. crasso.

TYPE LOCALITY: Hills west of Waivunu Creek, Serua Province, Viti Levu, Fiji; as type we designate *Smith* 9243, a flowering specimen.





FIGURES 17-19. *Calophyllum amblyphyllum*: 17 and 18 from *Smith* 9243, 19 from *Smith* 6449. 17, proximal surface of flower,  $\times 3$ ; 18, open flower,  $\times 3$ ; 19, cross section of fruit,  $\times 2$ . FIGURES 20, 21. *Calophyllum cerasiferum*: 20 from *Berry* 79, 21 from *Berry* 48. 20, cross section of fruit,  $\times 2$ ; 21, open flower,  $\times 3$ . FIGURE 22. *Calophyllum tenuicrustosum*: cross section of fruit, from *Smith* 4058,  $\times 2$ . m = mesocarp; e = endocarp; ot = outer layer of testa; c = cotyledons.

DISTRIBUTION: Fiji, Tonga, and Niue, occurring at elevations of 50-970 m. in dense or dry forest, on rocky forested slopes, or in crest thickets. It has been recorded as a tree 5-25 m. high, with a trunk diameter up to 60 cm.; the sepals are white or sometimes pink-tinged, the petals and filaments white, and the anthers yellow; the fruit, at first green, becomes



reddish-tinged and at length black. Flowers and fruits have been obtained more or less throughout the year.

LOCAL NAMES AND USE: *Ndamanu* (Fiji); *tamanu* (Niue). Like other forest species of *Calophyllum*, this new species is considered an important timber tree, producing a durable wood.

Fiji. VITI LEVU: MBA: Southern slopes of Mt. Ndelainathovu, on the escarpment west of Nandarivatu, *Smith* 4944 (A, BISH, K, NY, US); Sovutawambu, near Nandarivatu, *Degener* 14664 (A, K, NY). NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, *Smith* 5461 (A, BISH, K, NY, US). SERUA: Nambukelevu, upper Navua River, *Fiji Dept. Agr.* 15654 (BISH, MASS, SUVA); inland from Namboutini, *Fiji Dept. For.* 573 (or 797, or *Damanu* R-22) (BISH, K, SUVA); hills west of Waivunu Creek, between Ngaloa and Korovou, alt. 50–150 m., Nov. 23, 1953, *Smith* 9243 (US 2191735 holotype; isotypes at BISH, GH, K, NY, SUVA, UC); inland from Ngaloa, *Fiji Dept. For.* 574 (or 798, or *Damanu* G-22) (BISH, K, NY, SUVA); vicinity of Taunovo Creek, east of Wainiyambia, *Smith* 9576 (BISH, GH, K, NY, SUVA, UC, US). NAMOSI: Hills bordering Wainavindrau Creek, vicinity of Wainimakutu, *Smith* 8525, 8553 (both BISH, GH, K, NY, SUVA, UC, US); hills near Navua River, *Greenwood* 1036 (A, BISH, K). REWA: Nggoya Forest Reserve, *Fiji Dept. Agr.* 13764 (*Damanu* 124) (BISH, SUVA). VITI LEVU, without further locality: *Milne* 65 (K), 89 (K). OVALAU: *Horne* 43 (K); summit of Mt. Ndelaiovalau and adjacent ridge, *Smith* 7617 (BISH, GH, K, NY, SUVA, UC, US); vicinity of Levuka, *Gillespie* 4480 (BISH). VANUA LEVU: MATHUATA: Mt. Numbuiloa, east of Lambasa, *Smith* 6449 (A, BISH, K, NY, US). THAKAUNDROVE: Mt. Kasi, Yanawai River region, *Smith* 1789 (BISH, GH, K, NY, UC, US). TAVEUNI: Near crater lake east of Somosomo, *Smith* 8378 (BISH, GH, K, NY, SUVA, UC, US); valley between Mt. Manuka and Mt. Koroturanga, east of Wairiki, *Smith* 8286 (BISH, GH, NY, UC, US). FIJI, without further locality: *Horne* (GH), 732 (K).

Tonga. VAVA'U: *Crosby* 204 (K). KAO: *Yuncker* 15883 (BISH, BM, US). 'EUA: *Lister*, Dec. 1889 (K); near center of island, *Yuncker* 15326 (BISH, BM, US); near summit of eastern ridge, *Yuncker* 15435 (BISH, BM, GH, US). TONGA, without further locality: *Capt. Cook's 3rd Voyage* (BM).

Niue. Ana, near Hakapu-Liku Road, *Sykes* 821A (BISH), 823 (BISH).

Among the inland species of our region with 4 petals, the taxon here described has been confused with *Calophyllum vitiense*, *C. samoense*, and *C. neo-ebudicum*. However, examination of a now extensive suite of specimens shows that it should be excluded from each of these, differing from all three in its somewhat thicker leaf-blades with rounded or obtuse, only occasionally obtusely short-cuspidate, apices. It further differs from *C. vitiense* in its smaller flowers, different mesocarp, and thinner exocarp; from *C. samoense* in its quite different fruits; and from *C. neo-ebudicum* in its comparatively robust facies and somewhat larger fruits with a generally thicker endocarp. The absence of *C. amblyphyllum* from the Lau Group of Fiji and its reappearance in Tonga and Niue, while *C. samoense* occurs in Lau, disturbs the geographic pattern; but this may be explicable by the adaptation of the former to dense inland forests and the latter primarily to limestone areas. Or, of course, the actual geographic and ecological situation may remain to be clarified by future collecting.



Whitmore (1967: 14) cites *Horne* 732 and other Fijian collections as *Calophyllum cerasiferum*, a species with very different foliage, flowers, and fruits than the present taxon.

8. *Calophyllum cerasiferum* Vesque, Epharmosis 2: 10. *pl.* 32. 1889, in DC. Monogr. Phan. 8: 540, 585. 1893; J. W. Parham, Pl. Fiji Isl. ed. 2. 192. 1972. FIGURES 20, 21.

*Calophyllum burmanni* sensu Seem. in Bonplandia 9: 254. 1861, Viti, 433. 1862; Horne, A Year in Fiji, 258. 1881; non Wight.

*Calophyllum burmanni* var. *parvifolium* sensu Seem. Fl. Vit. 11. 1865; non Wight.

Tree to 15 m. high, the young parts obscurely glandular-puberulent, the terminal buds often somewhat vernicose, the branchlets comparatively stout and with short distal internodes, 2–4 mm. in diameter toward apex; petioles stout, semiterete or dorsiventrally flattened, 3–16 mm. long; leaf-blades coriaceous, ovate to obovate or elliptic-oblong, 3.5–8 cm. long, 1.3–5 cm. broad, acute to attenuate at base and decurrent on the petiole, rounded to subacute at apex or often short-cuspidate, the costa shallowly canaliculate above, prominent beneath, the secondary nerves 22–44 per centimeter, subplane above, prominulous beneath; inflorescences appearing racemose, 3–7-flowered, 1.2–5 cm. long at anthesis, to 7 cm. long in fruit, the peduncle stout, 0.4–1.8 cm. long; pedicels stout, 5–13 mm. long; flowers 12–20 mm. in diameter, the sepals ovate to elliptic, the outer ones 4.5–6 mm. in diameter, the inner ones  $8-9 \times 4.5-5.2$  mm.; petals sometimes 4 but often 5–9 and frequently 10, elliptic, 6–10 mm. long, 4–6 mm. broad, rounded and sometimes faintly erosulous distally; stamens usually 80–120, perhaps sometimes as many as 250, the filaments 3–5.5 mm. long at anthesis, sometimes distally divided, the anthers 0.8–1.3 mm. long; style 1–1.6 mm. long, the stigma peltate, 0.6–0.8 mm. in diameter; fruits subglobose, at maturity 18–25 mm. in diameter, coriaceous when dried, the pericarp 2–4 mm. thick, the mesocarp compactly fibrous, 1–3 mm. thick, adherent to the endocarp, this bony, 1–1.5 mm. thick; testa of seed with an outer spongy layer 2–3.5 mm. thick in young fruits, becoming compressed by the developing cotyledons.

TYPE LOCALITY: Mt. Voma, Namosi Province, Viti Levu, Fiji; the type is *Seemann* 49, a fruiting specimen. Although the presumed holotype is clearly marked "Voma peak," Seemann erroneously cited the number in 1865 as from Kandavu.

DISTRIBUTION: Endemic to Fiji and thus far known only from the uplands of Viti Levu at elevations of 600–1150 m., where it occurs in montane or hill forest often on ridges, or occasionally in secondary forest. It has been noted as a tree 2–15 m. high, with a trunk diameter up to 40 cm., often being stunted on exposed ridges; the sepals, petals, and filaments are white or cream-colored. Flowers, not previously described, have been collected in March and November, and fruits between August and November.



LOCAL NAMES AND USE: *Ndamanu* (as other species of the genus) or *ndamanu ndilondilo*. It has been noted as a useful timber, although since it is smaller than most Fijian *Calophylla*, such use must be limited.

Fiji. VITI LEVU: MBA: Waimongge Creek and vicinity, south of Nandarivatu, *Berry* 82 (BISH, MASS, SUVA, US), 85 (BISH, SUVA), 88 (BISH, MASS, SUVA, US). NANDRONGA & NAVOSA: South of Mt. Tomanivi, *Fiji Dept. Agr.* 14292 (BISH, K, SUVA); track to Vanualevu village, *Berry* 79 (MASS, SUVA). NAMOSI: Mt. Vakarongasiu, *Gillespie* 3267 (BISH); Mt. Voma, Aug. 24, 1860, *Seemann* 49 (K presumed holotype; isotypes at BM, GH); Mt. Voma track, *Fiji Dept. Agr.* 604 (SUVA). NAMOSI-NAITASIRI boundary: Summit of Mt. Naitarandamu, *Gillespie* 3232 (BISH, GH, UC). NAITASIRI: Vicinity of Rewasau, *Howard* 308 (BISH, SUVA, US); summit of Mendrausuthu Range, *Fiji Dept. Agr.* 15463 (MASS, SUVA), 15471 (BISH, SUVA).

This apparently rare and local species has become adequately known only through recent collecting. It is readily distinguished from other described Fijian *Calophylla* by its numerous petals; although occasional flowers are found to have only 4 petals, others in the same collection are seen to have 5–10 petals. Even in the absence of flowers, *C. cerasiferum* is sharply characterized by its robust, quadrangular branchlets with short distal internodes, its small, thick leaf-blades that are usually less than twice as long as broad, and its comparatively small, subglobose fruits with a compactly fibrous mesocarp and a bony, comparatively sturdy endocarp. The reference of Solomon Island specimens to *C. cerasiferum* (Whitmore, 1966: 77; 1967: 13) seems unjustified.

9. *Calophyllum tenuicrustosum* A. C. Sm. & S. Darwin, sp. nov.

FIGURE 22.

Arbor ad 20 m. alta, praeter partes juveniles et gemmam terminalem pilis glandulosis copiose sed minute ferrugineo-tomentellas plerumque mox glabrata, ramulis apicem versus 1.5–3 mm. diametro; petiolis 5–16 mm. longis sub anthesi interdum subpersistenter puberulis; foliorum laminis coriaceis anguste ellipticis vel lanceolatis vel lanceolato-oblongis, 5–10 cm. longis, 2–3.5 cm. latis, basi acutis et in petiolum decurrentibus, ad apicem acutum vel obtuse cuspidatum gradatim angustatis, costa supra leviter canaliculata subtus prominenti, nervis secundariis 15–35 per centimetrum utrinque subtiliter prominulis; inflorescentiis fecte racemosis vel interdum reductis (1–) 3–15-floris sub anthesi ad 6 cm. et sub fructu ad 11 cm. longis, pedunculo comparate crasso subnullo vel ad 3 cm. longo interdum ut partibus juvenilibus puberulo plerumque glabrato; bracteis sub floribus papyraceis ovatis ad  $3 \times 2$  mm. apice subacutis mox caducis, pedicellis ante anthesin 5–10 mm. sub fructu 8–12 mm. longis; floribus ante anthesin 12–16 mm. diametro, sepalis suborbicularibus circiter 6 mm. diametro saepe involutis; petalis 4–6 ellipticis 7–9 mm. longis 3.5–5 mm. latis, superne rotundatis et obscure erosulis; staminibus in alabastro vetusto circiter 200; fructibus ovoideo-ellipsoideis in sicco coriaceis et subrugulosis ad  $22 \times 18$  mm., pericarpio 1.5–1.8 mm. crasso,



mesocarpio compacte fibroso 0.2–0.5 mm. crasso ad endocarpium adhaerenti, hoc osseo 1–1.3 mm. crasso; testae seminis strato externo fibroso cotyledonibus evolutis endocarpium arcte adpresso.

TYPE LOCALITY: Mt. Evans Range, Mba Province, Viti Levu, Fiji; the type is *Smith 4058*.

DISTRIBUTION: Endemic to Fiji and thus far known from only a few collections on Viti Levu and Vanua Levu, these occurring in dense forest at elevations from near sea-level to 1,050 m. It has been noted as a tree 9–20 m. high, with a trunk to 50 cm. in diameter; the sepals and petals are white and the fruit green. Advanced flower buds were collected in September and November and fruits in April.

LOCAL NAME: Like other Fijian species of the genus, this is locally known as *ndamanu*.

Fiji. VITI LEVU: MBA: Natua Levu, Mt. Evans Range, *Fiji Dept. Agr. 14053* (BISH, SUVA); slopes of Mt. Nairosa, eastern flank of Mt. Evans Range, alt. 700–1,050 m., April 28, 1947, *Smith 4058* (A holotype; isotypes at BISH, K, NY, US). SERUA: Queen's Road, *Fiji Dept. Agr. 7036* (BISH, SUVA). VANUA LEVU: MATHUATA: Sasa Tikina (without other locality), *Howard 195* (MASS, SUVA).

Since good differentiating characters are found in the foliage and fruit, the best fruiting collection and one with several duplicates is designated as the type. The known distribution of this novelty is erratic both as to geography and altitude, but the cited specimens seem definitely conspecific. The best flowers are found on *Fiji Dept. Agr. 14053*, but even these are not quite mature. *Howard 195* has still younger inflorescences. However, the presence of four, five, or six petals in the flowers of the latter two collections indicates the relationship of this taxon to *Calophyllum cerasiferum*, a position confirmed by the general facies and the thin, fibrous mesocarp. From *C. cerasiferum* the new species differs in having its leaf-blades narrowly elliptic to lanceolate-oblong and usually about three times as long as broad, in the more obvious indument of its young parts and terminal buds, and in its proportionately narrower fruits with a distinctly thinner, almost negligible, mesocarp.

2. *Mammea* L. Sp. Pl. 512. 1753; Kosterm. *Mammea* and *Ochrocarpos*, For. Serv. Indones., Div. Plann. 11. 1956, in Commun. For. Res. Inst. Indones. 72: 2. 1961.

*Calysaccion* Wight, Illustr. Ind. Bot. 130. 1831; Seem. Fl. Vit. 13. 1865.

The taxonomic status of *Ochrocarpos* Thou. has puzzled students of the family, but the solution proposed by Kostermans (1956, 1961) seems logical and is here accepted. *Ochrocarpos* is typified by *O. madagascariensis* Thou. ex DC. and, in the interpretation of Kostermans, is limited to certain Madagascan taxa. *Mammea* L., typified by *M. americana* L., includes some 26 species in Asia, Malesia, and the Pacific, with a secondary center in Madagascar, a few species in tropical Africa, and only *M. americana* in America. In this interpretation, *Mammea* is characterized by the con-



spicuous and glanduliferous areoles of its leaf-blades and by the essentially free filaments, while *Ochrocarpos* has leaf-blades with bands of secretory canals crossing the secondary nerves and the filaments fascicled.

One widespread species and one Samoan endemic represent *Mammea* in our area. They are polygamo-dioecious trees, glabrous throughout; the branchlets are slightly flattened or subquadrangular in the distal internodes, turning from pale brown to grayish, with sparse, oval, slightly protruding lenticels. The opposite leaves have inconspicuously short-excavate petioles, the excavation at first enclosing the terminal bud, the petioles soon diverging to leave an interpetiolar pseudostipular line. The leaf-blades are coriaceous and entire, with spreading secondary nerves prominulous on both surfaces and interspersed with many less conspicuous ones; the principal nerves anastomose well within the margin but also continue outward to merge into an irregular collecting nerve close to the margin. The veinlets form a conspicuous reticulum (FIGURES 27, 28, 30, 31), resulting in areoles that in dried leaves are depressed on both surfaces and have a dark raised gland in the center. The inflorescences are axillary, often to scars of fallen leaves, fasciculate, and with 2-5 flowers, of which only one seems to mature. The flowers (FIGURES 24, 25) are pedicellate and subtended by closely imbricate bracts, with a calyx composed of 2 sepals that are completely fused in bud but separate at anthesis. The petals are usually 4 in *Mammea*, but in *M. odorata* they appear to be uniformly 6. The androecium of ♂ and ♀ flowers appears similar, composed of numerous essentially free stamens (FIGURE 25), of which the 2-celled anthers dehisce longitudinally. The gynoecium is lacking in ♂ flowers; in ♀ flowers it consists of a sessile, 4-locular ovary which soon becomes unilocular by abortion; the single ovule is basal and anatropous. The fruits, carnose when fresh, become coriaceous in drying; they are borne on branchlets below the leaves and are oblique or curved, with a single basally attached seed. The sepals are caducous and the stigma persistent. The pericarp (FIGURE 26) consists of a thin exocarp, a mesocarp that dries dense and hard, and a fibrous endocarp. The seed appears embedded in pulp when fresh, but the amount of this apparently varies with the species, and consequently a conspicuous or negligible air-space surrounds the seed in old fruits.

#### KEY TO SPECIES

- Branchlets and petioles robust, the former 4-6 mm. in diameter toward apex, the latter 3-5 mm. in diameter; leaf-blades concolorous, obovate or elliptic, usually 11-20 × 7-11 cm., the outer collecting nerve 1-3 mm. within margin; fruiting pedicels 7-17 mm. long, the fruit tapering to a manifest style about 2 mm. long, the stigma about 3 mm. in diameter, the endocarp 2-4 mm. thick, the seed embedded in pulp when fresh, this evanescent and leaving a conspicuous air-space in dried fruit. . . . . 1. *M. odorata*.
- Branchlets and petioles comparatively slender, the former 2-3 mm. in diameter toward apex, the latter 1.5-2.5 mm. in diameter; leaf-blades paler and glaucous beneath, elliptic to oblong, usually 7-14 × 3-5.5 cm. (juvenile



up to  $22 \times 8.5$  cm.), the outer collecting nerve 0.3–1 mm. within margin; fruiting pedicels 20–30 mm. long, the fruit tapering to a sessile stigma, this 3.5–4 mm. in diameter, the endocarp 0.5–1 mm. thick, the seed apparently appressed to the endocarp and not leaving a conspicuous air-space in dried fruit. . . . . 2. *M. glauca*.

1. **Mammea odorata** (Raf.) Kosterm. *Mammea* and *Ochrocarpos*, For. Serv. Indones., Div. Plann. 13. 1956, in Commun. For. Res. Inst. Indones. 72: 15. fig. 9, 10. 1961; J. W. Parham, Pl. Fiji Isl. ed. 2. 195. 1972. FIGURES 23–28.

*Lignum clavorum* Rumph. Herb. Amb. 3: 97. t. 64. 1743.

*Lolanara odorata* Raf. Fl. Tellur. 1: 16, nom. nud. 1837, op. cit. 2: 34. 1837.

*Calophyllum excelsum* Zoll. & Mor. Nat. Geneesk. Arch. Ind. 2: 582. 1845.

*Calysaccion obovale* Miq. Fl. Ind. Bat. Suppl. 500. 1861; Seem. in Bonplandia 9: 254. 1861; A. Gray in Proc. Am. Acad. Arts 5: 315. 1862; Seem. Viti, 433. 1862.

*Calysaccion tinctorium* Seem. Fl. Vit. 13. pl. 9. 1865.

"*Calyaccion tinctorum*" Horne, A Year in Fiji, 258. 1881.

*Ochrocarpus tinctorius* Drake, Ill. Fl. Ins. Mar. Pac. 116. 1890.

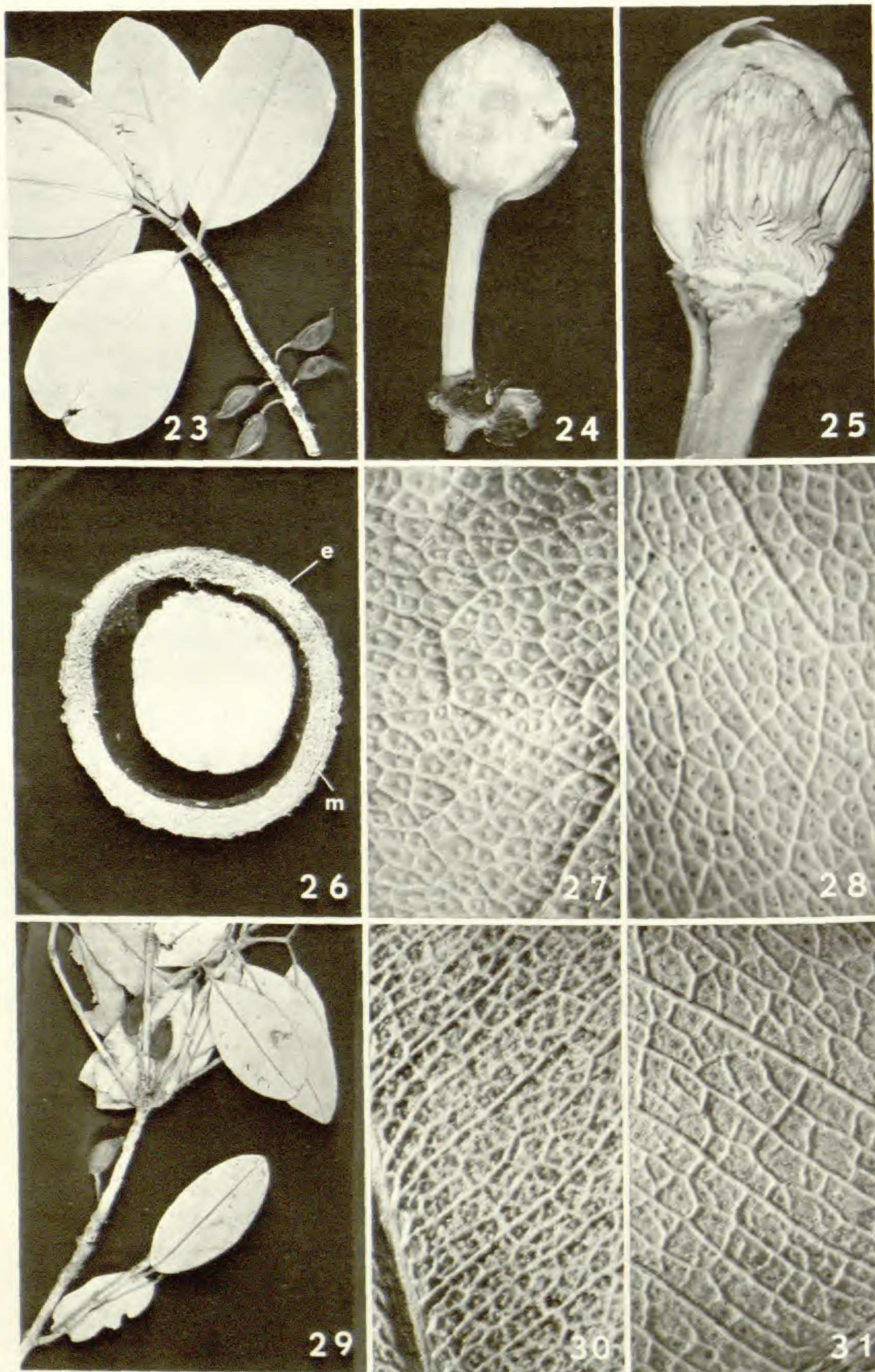
*Ochrocarpus excelsus* Vesque in DC. Monogr. Phan. 8: 525. 1893; Engl. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 21: 192. fig. 80, A–H. 1925.

*Ochrocarpos odoratus* Merr. in Jour. Arnold Arb. 26: 94. 1945.

*Ochrocarpus odoratus* Merr. ex J. W. Parham, Pl. Fiji Isl. 136. 1964.

Tree to 12 m. high, the branchlets stout, 4–6 mm. in diameter toward apex, soon thickening; leaves often distally congested, the petioles robust (3–5 mm. in diameter), semiterete or canaliculate, 8–20 mm. long; leaf-blades drying brown to dull green, concolorous, obovate or elliptic, (9–) 11–20 cm. long, (6–) 7–11 cm. broad, broadly obtuse to acute at base and decurrent on the petiole, rounded or retuse or abruptly cuspidate at apex (tip to 3 mm. long, obtuse or acute), recurved at margin, the costa stout, broadly flattened and often shallowly canaliculate above, prominent beneath, the principal secondary nerves 10–15 per side, irregularly anastomosing 5–10 mm. within margin and also forming an irregular outer collecting nerve 1–3 mm. within margin, the ultimate areoles often subquadrangular or pentagonal, 0.5–1 mm. in diameter; flowers borne on inconspicuous irregularly rounded protuberances 3–5 mm. broad, each subtended by 4–8 closely imbricate bracts, these chartaceous, broadly ovate,  $1-2 \times 2-3$  mm., obtuse, entire or obscurely erosulous; pedicels terete, 7–15 mm. long (to 17 mm. in fruit); flowers ellipsoid in bud, spreading at anthesis to 15–25 mm. in diameter; sepals papyraceous, elliptic,  $7-9 \times 5-7$  mm., obtuse or subacute at apex, with 15–18 parallel nerves; petals 6, broadly imbricate in bud, at length spreading, submembranaceous, obovate, at anthesis  $10-17 \times 4-7$  mm., obtuse to rounded at apex, entire or faintly erosulous at margin, with 10–15 ascending nerves dichotomously branched distally; androecium of ♂ flowers composed of about 200 stamens, the filaments filiform, 4–8 mm. long at anthesis, free or weakly connate in the basal 0.5 mm., the anthers oblong, 1.5–2 mm. long, the thecae





FIGURES 23-28. *Mammea odorata*: 23 from Smith 1263, 24 and 25 from Smith 1190, 26-28 from Fiji Dept. Agr. 16818. 23, branchlet with half-grown fruits,  $\times 1/5$ ; 24,  $\delta$  flower bud,  $\times 2\frac{1}{2}$ ; 25,  $\delta$  flower bud with sepals and 4



slightly exceeded by the obtuse connective; ♀ flowers similar to the ♂ but with a central gynoecium, the ovary ellipsoid, 2–2.5 mm. in diameter at anthesis, the style terete, about 2 mm. long, the stigma peltate, inconspicuously 2-lobed, about 2 mm. in diameter; fruits obliquely ellipsoid to ovoid, up to  $100 \times 50$  mm. at maturity, obtuse at base, narrowed distally to the persistent style and stigma, the stigma slightly accrescent, the pericarp 2–5 mm. thick, the mesocarp 0.5–1 mm. thick, the endocarp 2–4 mm. thick, the seed embedded in pulp when fresh, this evanescent, leaving a conspicuous air-space around the seed.

TYPE LOCALITY: Presumably Amboina; *Lolanara odorata* Raf. is based solely on *Lignum clavorum* Rumph., which may be considered typified by the Rumphian description and plate. The synonymy given above is incomplete, but as far as noted the nomenclatural usages and basionyms pertinent to the Fijian Region have been included. The complex synonymy of this much named species is more fully discussed by Merrill (1945) and Kostermans (1956, 1961). Of the basionyms involved, only *Calysaccion tinctorium* Seem. is typified by a plant from our area: *Seemann 46*, from Taveuni, Fiji, cited below. There are two sheets of this at Kew, on one of which the Taveuni locality is noted, with a comment: "In Mbau there was only one tree." This implies that Seemann saw the species on the islet of Mbau (Tailevu Province, Viti Levu) but not necessarily that any of his preserved material was obtained there.

DISTRIBUTION: Coastal areas throughout Malesia from Java and the Philippines, thence eastward to Micronesia and Fiji. Specimens from the New Hebrides have not been seen, but the species may be expected there. *Mammea odorata* seems not to have been recorded from Tonga, and the Samoan records probably all refer to *M. glauca*. In Fiji *M. odorata* is strictly littoral, occurring in beach thickets, often on limestone, or on the inner edge of mangrove swamps. It is a spreading tree 4–12 m. high, with white petals, filaments, and ovary, and with yellow anthers; as far as noted the fruits are green. Flowers and fruits do not seem seasonal.

LOCAL NAMES AND USES: *Vetao* or *vetau* are the usual Fijian names, but *uvitao* is also recorded. The close-grained wood is considered useful, and the latex was sometimes used by Fijians to dye their hair orange-brown.

Fiji. VITI LEVU: MBA: Namaka, *Fiji Dept. Agr. 11734* (BISH, SUVA). TAILEVU: Mokani, *Fiji Dept. Agr. 656* (SUVA); between Mokani and Ndravo, *Fiji Dept. Agr. 629* (A, SUVA), 15458 (SUVA). MBENGGA: Ndakuni, *Fiji Dept. Agr. 2075* (BISH, SUVA). KORO: Uthu ni Vanua, *Fiji Dept. Agr. 15831* (BISH, MASS, SUVA). VANUA LEVU: THAKAUNDROVE: Ndromoninuku, *Fiji Dept. Agr. 16818* (BISH, MASS, SUVA). TAVEUNI: Vicinity of Somosomo, May 1860, *Seemann 46* (K holotype of *Calysaccion tinctorium*; isotypes at BM, GH). KATAFANGA: *Fiji Dept. Agr.*, May 5, 1947 (BISH, SUVA). NAYAU: *Tothill 22* (K). KAMBARA: Lime-

petals removed,  $\times 5$ ; 26, cross section of fruit,  $\times 1$ ; 27, upper surface of leaf-blade,  $\times 5$ ; 28, lower surface of leaf-blade,  $\times 5$ . FIGURES 29–31. *Mammea glauca*: all from *Christophersen & Hume 2029*. 29, branchlet with fruits,  $\times 1/4$ ; 30, upper surface of leaf-blade,  $\times 5$ ; 31, lower surface of leaf-blade,  $\times 5$ . m = mesocarp; e = endocarp.



stone formation, *Smith 1263* (BISH, K, NY). FULANGA: Limestone formation, *Smith 1190* (BISH, GH, K, NY, UC, US). FIJI, without further locality: *Howard 133* (SUVA).

In the Kostermans revision of 1961, *Mammea odorata* would appear to be a taxonomically isolated species, but perhaps one may assume that from its forbear such local species as *M. papuana* (Lauterb.) Kosterm. and the Samoan *M. glauca* have been derived. As suggested by Merrill (1945), its fruits are probably dispersible by sea-water flotation.

2. ***Mammea glauca*** (Merr.) Kosterm. *Mammea* and *Ochrocarpos*, For. Serv. Indones., Div. Plann. 12. 1956, in Commun. For. Res. Inst. Indones. 72: 27. fig. 24. 1961. FIGURES 29–31.

*Ochrocarpus excelsus* sensu Christophersen in Bishop Mus. Bull. 128: 147. 1935; non Vesque.

*Ochrocarpos glaucus* Merr. in Jour. Arnold Arb. 26: 95. fig. 1. 1945.

*Mammea* sp. Kosterm. in Commun. For. Res. Inst. Indones. 72: 31. 1961.

*Mammea odorata* sensu B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 73. 1972; non Kosterm.

Tree to 18 m. high, the branchlets comparatively slender, 2–3 mm. in diameter toward apex; petioles comparatively slender (1.5–2.5 mm. in diameter), canaliculate, 10–17 mm. long (to 30 mm. on juvenile leaves); leaf-blades drying dull green above, paler and glaucous (in mature leaves) beneath with a thin waxy coating, elliptic to oblong, (4–) 7–14 cm. long, (2–) 3–5.5 cm. broad (up to  $22 \times 8.5$  cm. in juvenile leaves), obtuse at base and short-decurrent on the petiole, acute to obtuse or emarginate at apex (or on juvenile leaves cuspidate to short-acuminate), the costa stout, flattened or shallowly canaliculate above, prominent beneath, the principal secondary nerves 10–15 per side, irregularly anastomosing 3–7 mm. within margin (to 10 mm. in juvenile leaves) and also forming an irregular outer collecting nerve usually 0.3–1 mm. within margin, the ultimate areoles irregularly 3–5-sided, 0.3–1 mm. in diameter; flowers not seen, the flower-subtending bracts caducous in fruit but presumably several and imbricate; pedicels in fruit stout, subterete, 20–30 mm. long, slightly swollen at apex; fruits curved-ovoid, up to  $25 \times 15$  mm. (not fully mature), obtuse at base, narrowed distally to the persistent stigma, the sepals caducous, the style essentially none, the stigma peltate-bilobed, 3.5–4 mm. in diameter, recurved at margin, the pericarp 1–2 mm. thick, the mesocarp 0.5–1 mm. thick, the endocarp 0.5–1 mm. thick, the seed apparently appressed to the endocarp and not leaving a conspicuous air-space in drying.

TYPE LOCALITY: Medium wet forest above Matavanu, Savaii, Samoa; the type is *Christophersen & Hume 2029*, cited below.

DISTRIBUTION: Endemic to Samoa and thus far known only from Savaii, occurring in coastal and inland forest at elevations from near sea-level to 900 m. It has been recorded as a tree 15–18 m. high, with a



trunk to 40 cm. in diameter and lacking latex (note on type collection), with green fruits; the fruiting material available to us has been obtained in July, but Kostermans (1961) also cites *Vaupel* 566 from Falealupo as bearing fruits in December.

LOCAL NAMES AND USES: In upland Savaii the names *mamalava* and *taipoipo* have been noted, and in lowland forest the name *manapau*. B. E. V. Parham, recording the species as *Mammea odorata*, indicates that the timber is heavy and has been used for making clubs.

Samoa. SAVAII: Vicinity of Falealupo, *Christophersen* (coll. *Stehlin*) 2664 (BISH), *Christophersen* 3318 (BISH, NY, UC); above Matavanu, July 15, 1931, *Christophersen & Hume* 2029 (A holotype; isotypes at BISH, K, NY, P, UC, US), 2053 (BISH).

This Samoan endemic was presumably derived from the inland movement of a population of *Mammea odorata*, although in its typical form the latter seems now to be lacking from Samoa. While *M. odorata* is strictly a strand plant or is associated with mangroves, the lowland representatives of the genus in Samoa occupy a forest niche. The two such collections that we have seen, those from the vicinity of Falealupo, are sterile and apparently from juvenile plants; their leaves are more robust than those of the montane specimens, but in shape and other characteristics they definitely represent *M. glauca* rather than *M. odorata*. Lacking flowers of *M. glauca*, we may still point to reproductive differences between it and *M. odorata*. In the Samoan endemic, the fruits have a negligible style and a comparatively large, recurved, distinctly bilobed stigma, and it seems probable that the seed is embedded in comparatively sparse pulp, so that a minimal air-space is left within the fruit at maturity.

In his 1961 revision, Kostermans (p. 31) lists *Christophersen* 3318 as an undescribed Samoan species, overlooking the fact that he had (p. 28) also cited this collection as *Mammea glauca*, a disposition that seems correct to us.

### 3. *Garcinia* L. Sp. Pl. 443. 1753; Seem. Fl. Vit. 10. 1865.

In his voluminous work on the forest flora of CochinChina (1879–1907), Pierre (1883: 1: I–XL. *pl.* 54–92) discusses *Garcinia* at length, providing excellent illustrations of many species, and comments on several from our area. Many of his sections have been retained by Engler (1925), but only three of them appear to extend eastward into the Fijian Region, where the diversity of this complex genus, of more than 200 species, has become greatly attenuated.

The species of our area are dioecious trees, often copiously laticiferous and with secretory canals in the foliage and flowers, glabrous throughout. The branchlets are subquadrangular or slightly flattened in the distal internodes and there brownish or purplish, soon becoming subterete and grayish, with sparse, small, oval lenticels. The opposite leaves have petioles that are semiterete or shallowly canaliculate, excavate basally around



the terminal bud, soon diverging and leaving an interpetiolar pseudo-stipular line (FIGURE 40) or scar (FIGURE 48); the excavation may be distally produced into a conspicuous ligule (FIGURE 38) or not. The leaf-blades are coriaceous to chartaceous or membranaceous, drying dull green or brownish, with secondary nerves spreading or subascending from a curved base. The inflorescences in our species are terminal at inception and cymose, or axillary (often to caducous leaves) and fasciculate or glomerulate, with small but usually obvious flower-subtending bracts. The flowers are pedicellate or sessile, the 4, 6, or 8 decussate perianth-segments with obscure nerves or more obvious longitudinal secretory canals. The androecium is highly diverse in the ♂ flowers, providing a basis for sectional recognition. An androecial rudiment may be present or absent in ♀ flowers, which have a superior sessile ovary with 2 or several (FIGURE 37) or many locules. The ovules are solitary in each locule, axile (FIGURE 55) or subascending, and anatropous; in our species the stigma is sessile or nearly so. The fruit is baccate or drupaceous, carnose when fresh but drying either smooth or costate, depending upon the texture of the endocarp.

The following key is based only on the species of our area and does not incorporate the full range of variation present in the three sections represented. We here recognize five species, one of which is described as new.

#### KEY TO SPECIES

Petioles with the proximal excavation distally produced into a conspicuous ligule 1.5–4 mm. long; leaf-blades with secondary nerves 6–16 per centimeter; inflorescences terminal at inception, cymose, with paired bracts at the nodes; sepals and petals each 4; ♂ flowers with the androecium composed of 60–100 stamens aggregated into 4 phalanges opposite the petals, a sterile central gynoecium present; ovary of ♀ flowers with (4–) 5 or 6 locules; fruits ovoid to obovoid, often apiculate with the persistent short style and accrescent stigma, with (4–) 5 or 6 seeds, the dissepiments thin, the sepals persistent (Sect. MANGOSTANA); New Hebrides, Fiji, and Tonga.

..... 1. *G. pseudoguttifera*.

Petioles with the proximal excavation not produced into a ligule; leaf-blades with 1–3 (–8) secondary nerves per centimeter; inflorescences axillary, often to caducous leaves, fasciculate or glomerulate, the flowers arising from a pulvinate or irregularly subglobose or short-cylindric peduncle; sepals and petals often each 4, sometimes fewer; fruits ellipsoid, the stigma strictly sessile, persistent, pulvinate-discoid.

Pedicels obvious, 3–12 (–15) mm. long, distally swollen into an inconspicuous flattened receptacle; androecium of ♂ flowers composed of numerous (up to 700) stamens aggregated into 4 phalanges opposite the petals, a sterile central gynoecium present; ovary of ♀ flowers with 2 locules; fruits smooth in drying, the seeds 2, the dissepiment thin, the sepals caducous, the stigma conspicuously accrescent (Sect. DISCOSTIGMA).

Flowers comparatively small, the sepals 1.5–3.5 × 1.5–4 mm., the petals 3–4.5 × 2.5–3.5 mm., the androecium in ♀ flowers lacking or forming an obscure annulus hardly 0.1 mm. high; mature fruits 13–16 × 12–14 mm.; petioles 2–10 mm. long; leaf-blades 4–11 × 1.2–5 cm., at-



tenuate at base and long-decurrent on the petiole; New Hebrides and Fiji. . . . . 2. *G. vitiensis*.

Flowers larger, the sepals  $3-5 \times 4-7$  mm., the petals  $3-6 \times 3-7$  mm., the androecium in ♀ flowers composed of short-oblong phalanges 0.5-0.7 mm. high; mature fruits  $20-45 \times 15-30$  mm.; petioles 4-20 (-25) mm. long; leaf-blades usually  $7-17 \times 4-11$  cm., obtuse at base and short-decurrent on the petiole; Fiji and Tonga. . . . . 3. *G. myrtifolia*.

Pedicels lacking or minute, rarely as long as 2.5 mm., imperceptibly enlarging into the calyx; androecium of ♂ flowers central, composed of 7-30 stamens fused into a carnose stalk, the anthers sessile or essentially so, a gynoecium lacking; ovary of ♀ flowers with 5-13 locules; fruits costate in drying, the seeds 5-13, enclosed in pyrenes separated by air-chambers or pulp, the endocarp of each pyrene bony or horny, the sepals persistent, the stigma only slightly accrescent (Sect. MUNGOTIA).

Corolla composed of 4 petals, these very early becoming marginally imbricate and soon conspicuously so; inflorescences composed of 3-9 flowers, the flower-subtending bracts usually 2 per flower; fruits with a mesocarp 0.5-1.5 mm. thick, sharply (6-) 10-13-costate when dried, the pyrenes (6-) 10-13, with bony endocarps 0.2-1 mm. thick, obtuse to narrowly rounded on the dorsal face; leaf-blades usually chartaceous to membranaceous, obtuse to acute at base; Santa Cruz Islands, Fiji, Tonga, and Samoa. . . . . 4. *G. sessilis*.

Corolla composed of 2 valvate petals, these with thick margins broadly appressed to each other; ♂ inflorescences usually composed of 15-40 flowers, rarely of 3-7 flowers in distal inflorescences, the flower-subtending bracts often more than 2 per flower; fruits with a mesocarp 2-3 mm. thick, obtusely 5-8-costate when dried, the pyrenes 5-8, with horny endocarps 1-4 mm. thick, broadly rounded on the dorsal face; leaf-blades subcoriaceous to chartaceous, acute to attenuate at base; Fiji. . . . . 5. *G. adinantha*.

1. *Garcinia pseudoguttifera* Seem. Fl. Vit. 11. 1865; Horne, A Year in Fiji, 262. 1881; Pierre, Fl. For. Cochinch. 1: XL. 1883; Vesque in DC. Monogr. Phan. 8: 483. 1893; Yuncker in Bishop Mus. Bull. 220: 188. 1959; J. W. Parham, Pl. Fiji Isl. 134. 1964, ed. 2. 194. 1972. FIGURES 32-39.

*Garcinia echinocarpa* sensu Seem. in Bonplandia 9: 254. 1861; non Thw.

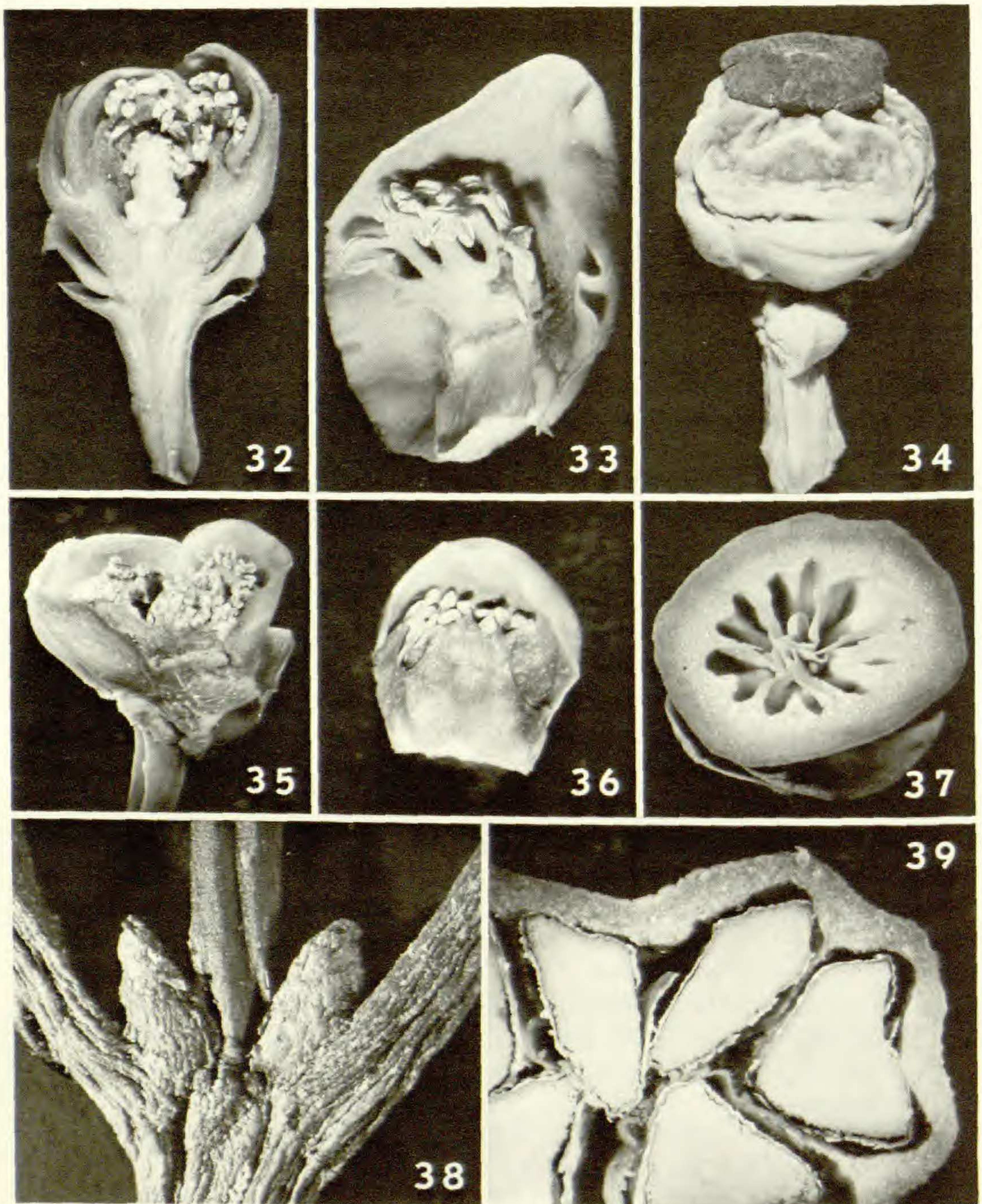
*Garcinia pedicellata* Seem. Viti, 433, quoad spec. vit., non sensu typi. 1862.

*Garcinia* sp. n. Horne, A Year in Fiji, 262. 1881.

*Garcinia pancheri* sensu Guillaumin in Jour. Arnold Arb. 12: 226. 1931; non Pierre.

Tree to 25 m. high, the branchlets 1.5-4.5 mm. in diameter toward apex; petioles slender to robust, 10-35 mm. long, conspicuously excavate, the excavation distally produced into a conspicuous ligule, this coriaceous, oblong-ovate, rounded distally, free from petiole in the ultimate 1.5-4 mm.; leaf-blades coriaceous, ovate to oblong-elliptic or slightly obovate, (4-) 6-17 cm. long, (2.5-) 3.5-12 cm. broad, obtuse to attenuate at base and decurrent on the petiole, obtusely cuspidate to rounded or sometimes retuse at apex, entire and often narrowly recurved at margin, the costa





FIGURES 32-39. *Garcinia pseudoguttifera*: 32 from Yunker 16204, 33 from Kajewski 831, 34 from Smith 4464, 35 from Fiji Dept. Agr. 13936, 36 from Smith 997, 37 from Smith 7143, 38 from Smith 6308, 39 from Smith 217. 32, section of ♂ flower, showing 2 phalanges and sterile gynoecium,  $\times 3$ ; 33, petal and phalange of ♂ flower,  $\times 4$ ; 34, developing gynoecium, with persistent sepals,  $\times 3$ ; 35, section of ♂ flower, showing 2 phalanges,  $\times 3$ ; 36, petal and phalange of ♂ flower,  $\times 4$ ; 37, cross section of developing gynoecium,  $\times 3$ ; 38, petiole-bases, showing the conspicuous ligules,  $\times 5$ ; 39, cross section of fruit,  $\times 2$ .



stout, plane or slightly raised above, prominent beneath, the secondary nerves 6–16 per centimeter, spreading, irregularly anastomosing, prominulous on both surfaces, joined in a collecting nerve 0.2–1 mm. within margin, the veinlet-reticulation sparse, immersed or prominulous on both surfaces, sometimes parallel to secondaries; inflorescences terminal at inception, sometimes on short lateral branchlets, cymose, the ♂ 3–5-times branched, 5–40-flowered, up to 6 cm. long and 10 cm. broad, the ♀ usually 2- or 3-times branched, 1–7-flowered (flower often solitary and terminal), up to 3 × 3 cm. at anthesis and to 7 cm. long in fruit, the peduncle stout, usually 3–15 mm. long but sometimes lacking; bracts at inflorescence-nodes paired, subcoriaceous, ovate or oblong, obtuse, 2–5 mm. long, the flower-subtending bracts similar or semi-orbicular, to 1 × 2 mm.; pedicels (above ultimate articulation) inconspicuous, 1–6 mm. long, in ♀ flowers scarcely exceeding 4 mm., becoming stout and often sulcate in fruit; flowers in ultimate groups of 2 or 3, but usually solitary in ♀ and sometimes ♂ inflorescences, 10–17 mm. in diameter at anthesis, the perianth-segments often with immersed opaque glands; sepals 4, decussate, thick-carnose, broadly ovate or suborbicular, rounded at apex, entire or undulate, the outer ones 3–4 × 4–8 mm., the inner ones 4–5 × 5–9 mm.; petals 4, broadly imbricate, thick-carnose, orbicular to broadly obovate, 6–10 mm. long, 5–9 mm. broad, rounded, entire; androecium of ♂ flowers cupuliform, composed of 60–100 stamens aggregated into 4 phalanges opposite the petals, each phalange carnose, 3–7 mm. long, irregularly divided at margin, the anthers single or in small clusters, basifixed, ovoid or ellipsoid, 0.5–1 mm. long, laterally dehiscent, the gynoecium in ♂ flowers minute or oblong, irregular, solid, to 3 mm. long; ♀ flowers with a subglobose ovary 3–4 mm. in diameter at anthesis, the wall thick-carnose, with copious longitudinal mucilage-canals, the dissepiments thin, the locules (4–) 5 or 6, often bilobed on the extrorse face, the style none or stout and very short, the stigma peltate to rounded, 2–3 mm. in diameter at anthesis, minutely tuberculate, often becoming inconspicuously 4–9-lobed, the androecium in ♀ flowers composed of 4 dendroid phalanges adnate to petals and bearing small irregular staminodia; fruits carnose at maturity, becoming coriaceous in drying, ovoid to obovoid, to 50 × 40 mm. (but perhaps sometimes larger), often apiculate with the persistent short style and enlarged stigma to 8 mm. in diameter, the pericarp variable in thickness, 1.5–10 mm. thick, the dissepiments persistent, the locules (4–) 5 or 6; seeds curved-ellipsoid, angled on inner edge, convex or bilobed on extrorse face, to 20 mm. long and 10 mm. broad.

**TYPE LOCALITY:** In his protologue Seemann mentions "Kandavu, in mountainous woods," but the holotype bears the inscription "Wood about Navua." Seemann (1862) visited the lower Navua River on three occasions, in July, August, and September, 1860, and Kandavu twice, in August and September. As his material was doubtless sorted after his return to England, it is likely that the data with the specimens are the more accurate. The type, *Seemann 50*, is cited below as from the vicinity of Navua, Serua Province, Viti Levu.



**DISTRIBUTION:** New Hebrides, Fiji, and Tonga, occurring with some frequency in the first two archipelagoes but apparently collected only once in Tonga. It has been noted at elevations from near sea-level to 450 m. (New Hebrides) or 1,150 m. (Fiji), in dense or thin forest or sometimes in beach thickets, as a tree 4–25 m. high with a trunk diameter up to 30 cm. (which is probably exceeded) and with abundant yellow or pale latex. The petals are yellowish white, becoming pale pink to red; the fruit is usually noted as green, but becomes red or perhaps darker at maturity. Flowers and fruits have been obtained throughout the year.

**LOCAL NAMES AND USES:** *Neyaheven* has been recorded in the New Hebrides and *mo'onia* in Tonga. In Fiji the frequently used names are *kau yalewa*, *mbulu*, *mbuluwai*, or *mbuliwai*, but also noted are *sueri*, *mali*, *sarosaro*, *mbulumangayalewa*, *mbulumanga*, and *nambulinomati*. The fruit is considered edible in both the New Hebrides and Fiji; and in the latter archipelago the plant is sometimes used for timber, an extract of the leaves is used to relieve pain, and oil from the fruit is used as a perfume.

**New Hebrides.** VANUA LAVA, Banks Group: *Kajewski* 414 (A), 415 (A, NY). EPI: Mont Alembe, *Aubert de la Rüe*, Nov. 21, 1935 (A, P). EROMANGA: Inland from Dillon Bay, *Kajewski* 342 (A, BISH, NY, US), 389 (A, NY); Ulenarap, S. River, *Johnson* 19 (A, K). ANEITYUM: Anelgauhat Bay, *Kajewski* 831 (A, BISH, NY, US).

**Fiji.** YASAWAS: WAYA: Along Wailevu Creek, *St. John* 18072 (BISH, SUVA, US); vicinity of Nangua, *St. John* 18153 (BISH, SUVA, US). VITI LEVU: MBA: Mountains near Lautoka, *Greenwood* 507A (A, BISH); vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith* 4464 (A, BISH, K, NY, US); Naloto Range, *Fiji Dept. Agr.* 14761 (BISH, SUVA), 14775 (SUVA); vicinity of Nandarivatu, *Tothill* (K), *Gillespie* 3881, 4194 (both BISH, GH, UC); Mt. Nanggaranambuluta, *Smith* 6308 (A, US); slopes of Mt. Tomanivi, *Gillespie* 4077 (BISH, GH, NY, UC), *Smith* 5216 (A, BISH, K, NY, US). NANDRONGA & NAVOSA: Vicinity of Nandrau, *Berry* 70 (BISH, MASS, SUVA), *Fiji Dept. For.* 1178 (BISH, SUVA); northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, *Smith* 5498, 5552 (both A, BISH, K, NY, US). SERUA: Rovondrau Bay, *Fiji Dept. Agr.* 7199 (SUVA), 7203 (SUVA); Ndeumba, *Fiji Dept. Agr.* 16977 (SUVA); Koromba Beach, *Fiji Dept. Agr.* 15277 (MASS, SUVA); vicinity of Navua, July–Sept. 1860, *Seemann* 50 (K holotype; isotypes at BM, GH). NAMOSI: Northern slopes of Korombasambasanga Range, in drainage of Wainavindrau Creek, *Smith* 8753 (BISH, GH, US). RA: Vicinity of Rewasa, near Vaileka, *Degener* 15392 (A, BISH, K, NY, P, UC, US), 15495 (A, BISH, NY, US). NAITASIRI: Between Viria and Namuamua, *Fiji Dept. Agr.* 68 (SUVA); Waindrandra Creek, *Fiji Dept. Agr.* 795 (SUVA); between Nawangasua and Nanduna, *Fiji Dept. Agr.* 639 (SUVA); vicinity of Tamavua, *Gillespie* 2196 (BISH). TAILEVU: East of Wainimbuka River, vicinity of Ndakui-vuna, *Smith* 7143 (BISH, GH, K, NY, SUVA, UC, US). KANDAVU: Mt. Mbuke Levu, *Smith* 217 (BISH, GH, K, NY, UC, US); Lutumatavoro, *Fiji Dept. Agr.* 14925 (A, NY, SUVA). OVALAU: West of Lovoni Valley, on ridge south of Mt. Korolevu, *Smith* 7544, 7637 (both BISH, GH, K, NY, SUVA, UC, US); hills above Levuka, *Gillespie* 4438 (BISH), 4510 (BISH, UC). MAKONGAI: *Tothill* 23 (K). KORO: Eastern slope of main ridge, *Smith* 997 (BISH, GH, K, NY, UC, US). VANUA LEVU: MBUA: Southern portion of Seatovo Range, *Smith* 1557 (BISH, NY); Wainunu



Valley, *Fiji Dept. Agr.* 15761 (SUVA), 15794 (SUVA). MATHUATA: Above Nasin-gasinga, *Berry* 51 (SUVA); Mt. Ndrandramea, *Fiji Dept. Agr.* 15386 (SUVA); Nanduri, *Tothill* F435 (BISH, K); Seanggangga Plateau, *Smith* 6894 (A, BISH, NY, US), *Fiji Dept. Agr.* 13936 (BISH, SUVA); Tambia River area, *Howard* 410 (SUVA); Mt. Numbuiloa, east of Lambasa, *Smith* 6552 (A, BISH, NY, US). THAKAUNDROVE: Mt. Kasi, Yanawai River region, *Smith* 1801 (BISH, GH, K, NY, UC, US); Tuvamila, Natewa Peninsula, *Howard* 73 (SUVA). RAMBI: *Horne* 450 (GH, K). TAVEUNI: Vicinity of Waiyevo, *Gillespie* 4633 (BISH); Mt. Manuka, east of Wairiki, *Smith* 8319 (BISH, GH, NY, US). MOALA: Near Maluku, *Smith* 1335 (BISH, GH, K, NY, UC, US). VANUA MBALAVU: *Tothill* 23a (K); northern limestone section, *Smith* 1471 (BISH, GH, K, NY, UC, US). FIJI, without further locality: *U. S. Expl. Exped.* (GH).

**Tonga.** VAVA'U: Near Mataika, north of Neiafu, *Yuncker* 16204 (BISH, GH, US).

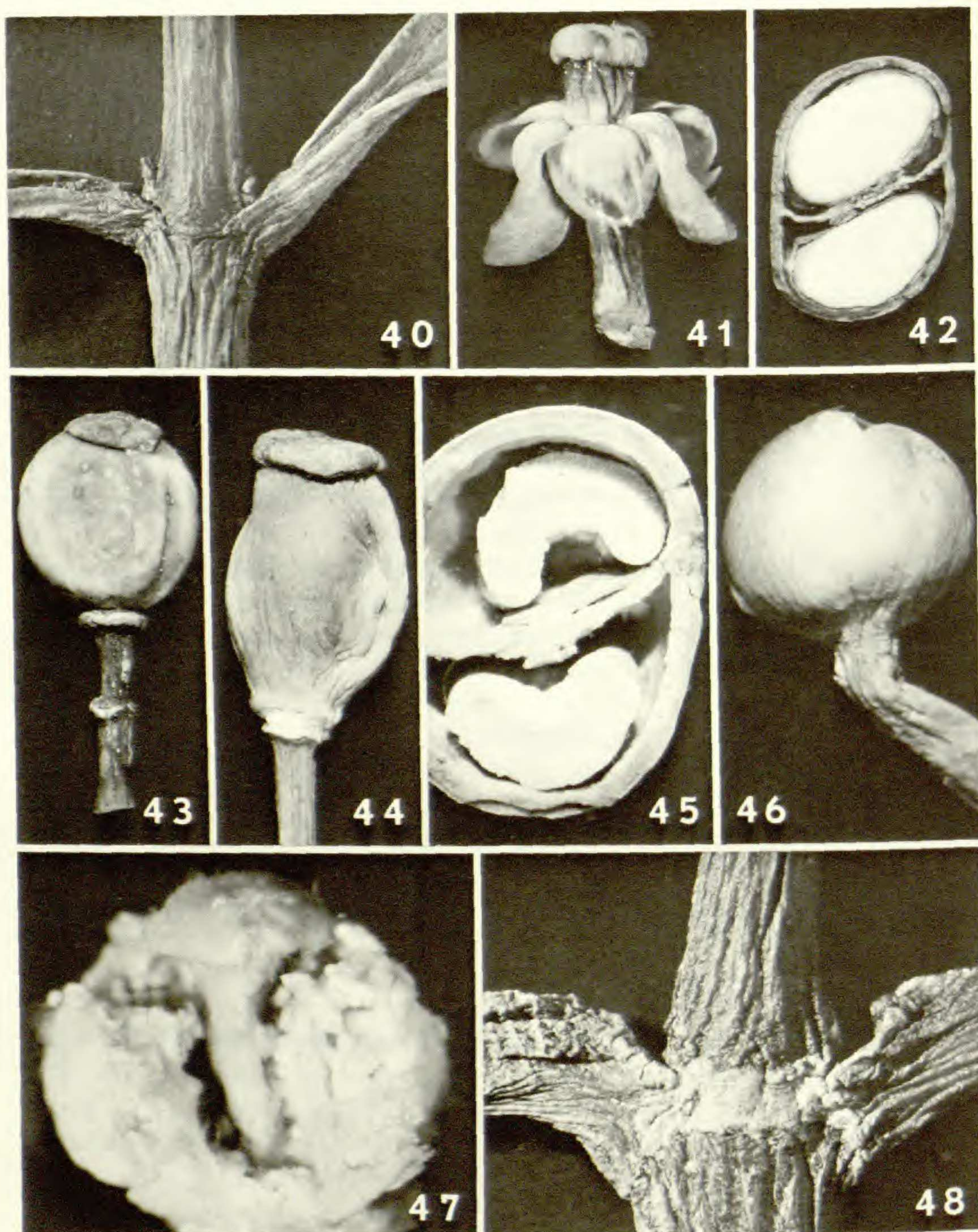
The New Hebridean specimens cited above, including those listed by Guillaumin in 1931 as *Garcinia pancheri*, are clearly referable to *G. pseudoguttifera*. They are scarcely distinguishable in facies and foliage from many Fijian collections; their androecia have phalanges (FIGURE 33) inclined to be distally divided into branches composed of several filaments, whereas in Fiji the phalanges (FIGURE 36) are often irregular and bear individual anthers, but throughout the taxon the form of phalange is highly variable as to the degree of filament-fusion. *Garcinia pancheri* Pierre (1883: 1: XXV. pl. 89, D), apparently a New Caledonian endemic, differs superficially from *G. pseudoguttifera* in its smaller leaf-blades with fewer secondary nerves, its less complex and fewer-flowered ♂ inflorescences, and its smaller sepals and petals. Pierre placed his species in Sect. MUNGOTIA, the stamens being 26–32 in number and aggregated on the convex summit of a tetragonal axis. The species is not mentioned by Engler (1925), but in his treatment it would seem correctly placed in Sect. MUNGOTIA, although Vesque (1893: 274, 435) referred it to Sect. CAMBOGIA. In either case it is only remotely related to *G. pseudoguttifera*, which seems best placed in Sect. MANGOSTANA.

Seemann (1862: 433) correctly proposed the binomial *Garcinia pedicellata* for *Clusia pedicellata* Forst. f. (Fl. Ins. Austr. Prodr. 74. 1786), erroneously referring to it his no. 50. In 1865 Seemann clarified the matter by describing *G. pseudoguttifera* and amplifying his concept of *G. pedicellata* as a presumable New Caledonian endemic. Neither Pierre (1883: 1: XL) nor Vesque (1893: 483) has further elaborated the status of *G. pedicellata*.

2. ***Garcinia vitiensis*** (A. Gray) Seem. Fl. Vit. 10. 1865; Horne, A Year in Fiji, 262. 1881; Pierre, Fl. For. Cochinch. 1: XXXVI. 1883; Vesque in DC. Monogr. Phan. 8: 365. 1893; Engl. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 21: 223. 1925; Guillaumin in Jour. Arnold Arb. 12: 227. 1931; J. W. Parham, Pl. Fiji Isl. 136. 1964, ed. 2. 195. 1972. FIGURES 40–43.

*Discostigma vitiense* A. Gray, Bot. U. S. Expl. Exped. 1: 216. 1854, Atlas





FIGURES 40-43. *Garcinia vitiensis*: 40 from Smith 9420, 41 from Fiji Dept. Agr. 15482, 42 from Smith 6818, 43 from Smith 5066. 40, young branchlet and petioles,  $\times 5$ ; 41, ♀ flower,  $\times 5$ ; 42, cross section of fruit,  $\times 2$ ; 43, developing gynoecium,  $\times 3$ . FIGURES 44-48. *Garcinia myrtifolia*: 44 from Smith 4573, 45 from Parks 16260, 46 and 47 from Hürlimann 258, 48 from Degener 14651. 44, developing gynoecium,  $\times 3$ ; 45, cross section of fruit,  $\times 2$ ; 46, ♂ flower bud,  $\times 5$ ; 47, androecium of ♂ flower, with phalange removed to show sterile gynoecium,  $\times 10$ ; 48, young branchlet and petiole-bases,  $\times 5$ .



*pl.* 16, *A.* 1856; Seem. Viti, 433. 1862.

*Garcinia* *sp. n.* Horne, *A Year in Fiji*, 262. 1881.

Tree to 25 m. high, the branchlets 1–2.5 mm. in diameter toward apex; petioles often slender, 2–10 mm. long; leaf-blades coriaceous or thick-chartaceous, elliptic to lanceolate, 4–11 cm. long, 1.2–5 cm. broad, attenuate at base and long-decurrent on the petiole, obtuse to obtusely acuminate at apex (acumen to 10 mm. long), entire and thickened-recurved at margin, the costa plane or sharply elevated above, subprominent beneath, the secondary nerves 2–8 per centimeter, ascending or subspreading, prominulous on both sides or immersed above and plane beneath, inconspicuously joined in a collecting nerve 0.5–1 mm. within margin, obscurely interconnected by a veinlet-reticulation, this usually immersed or sometimes faintly prominulous beneath; ♂ inflorescences not seen; ♀ inflorescences axillary, fasciculate, composed of 1–4 flowers arising from an inconspicuous pulvinate peduncle, the flower-subtending bracts subcoriaceous, ovate-deltoid, 0.5–1 mm. long and broad, obtuse; pedicels subterete or subquadrangular, 4–10 mm. long, sometimes articulate near middle and there bibracteolate (bracteoles slightly smaller than bracts), distally swollen into an inconspicuously flattened receptacle; perianth composed of 3 or 4 decussate pairs of segments, 5–8 mm. in diameter at anthesis; sepals 4, rounded, the outer ones papyraceous, ovate, 1.5–3 × 1.5–2.5 mm., entire and sometimes inflexed at margin, with immersed nerves, the inner ones submembranaceous or papyraceous, suborbicular, 3–3.5 × 3–4 mm., entire or faintly erosulous at margin, with about 12 inconspicuous ascending nerves; petals 2 or 4, broadly imbricate, submembranaceous, elliptic or suborbicular, 3–4.5 mm. long, 2.5–3.5 mm. broad, rounded, entire or faintly erosulous at margin, with 12–15 inconspicuous ascending nerves; ♀ flowers with a carnose, ovoid to obovoid ovary 1–1.5 mm. long and in diameter at anthesis, the wall thick-carnose, the dissepiment thin, the locules 2, the stigma strictly sessile, carnose, pulvinate-discoid, 2–2.5 mm. in diameter, smooth or faintly tuberculate, the androecium in ♀ flowers often lacking but sometimes forming an obscure 4-lobed annulus less than 0.1 mm. high; fruits carnose at maturity, becoming coriaceous in drying, ellipsoid, 13–16 mm. long, 12–14 mm. broad, often cicatricose at base with scars of caducous perianth-segments, surmounted by the persistent stigma, this accrescent to 6 mm. in diameter, the pericarp about 0.5 mm. thick, the dissepiment persistent, thin, chartaceous, the locules 2; seeds semi-ellipsoid, filling the locules.

TYPE LOCALITY: Ovalau, Fiji; the type is a U. S. Exploring Expedition specimen, cited below.

DISTRIBUTION: The New Hebrides and Fiji, apparently rare in the former archipelago, but occasional on high islands in the second. The species occurs at elevations from near sea-level to 1,050 m., in dense, open, or rocky forest, or on forested ridges. It is a tree 3–25 m. high, sometimes compact or slender, and with pale latex; the sepals are pale green, the petals cream-colored, the stigma yellow, and the fruit turning



from green to reddish purple and becoming black at maturity. No staminate flowers have been seen, but pistillate flowers have been obtained in March and April; fruits in various stages seem to persist throughout the year.

LOCAL NAME AND USE: The name *asivula* has been recorded in Mba Province, Fiji; Kajewski notes that the tree is common on Aneityum, New Hebrides, and that the wood is durable.

**New Hebrides.** EROMANGA: Southeastern part of island, *Schmid* 3207 (P). ANEITYUM: Anelgauhat Bay, *Kajewski* 840 (A, BISH, NY).

**Fiji.** VITI LEVU: MBA: Mt. Ndelaiyoö, west of Nandarivatu, *Smith* 5066 (A, BISH, K, NY, US); vicinity of Nandarivatu, *Tothill* 150 (K). SERUA: Inland from Yarawa, *Fiji Dept. For.* 1048 (A, K); north of Ngaloa, in drainage of Waininggere Creek, *Smith* 9420 (BISH, GH, K, NY, UC, US). NAMOSI: Mt. Vakarongasiu, *Fiji Dept. Agr.* 16130 (BISH, SUVA). NAITASIRI: Mendrausuthu Range, *Fiji Dept. Agr.* 15482 (MASS, SUVA); Tholo-i-suva, *Fiji Dept. Agr.* 117 (SUVA); Prince's Road, *Fiji Dept. Agr.* 1621 (SUVA). REWA: Mt. Korombamba, *Fiji Dept. Agr.* 16504 (BISH, MASS, SUVA), *Webster & Hildreth* 14085 (MASS). OVALAU: In 1840, *U. S. Expl. Exped.* (US 11515 holotype; isotype at GH). NGAU: East of Herald Bay, inland from Sawaieke, *Smith* 7760, 7761 (both BISH, GH, K, NY, SUVA, UC, US). VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, *Smith* 6690 (A, BISH, K, NY, US), 6818 (A, BISH, US); Mt. Numbuiloa, east of Lambasa, *Smith* 6440 (A, US), 6577 (A, BISH, K, US); Wainikoro River, *Greenwood* 700 (A, K). THAKAUNDROVE: Between Waiwai and Lomaloma, *Horne* 630 (GH, K). FIJI, without further locality: *Horne* 1095 (GH, K).

Although represented by many specimens with fruits in various stages, and by a few with ♀ flowers, *Garcinia vitiensis* seems still unknown as to its ♂ flowers. Nevertheless, it is certainly correctly referred to Sect. DISCOSTIGMA by Pierre, Vesque, and Engler. Most available ♀ flowers have no trace of an androecium, but sometimes a minute, 4-lobed annulus is present as a vestige.

3. *Garcinia myrtifolia* A. C. Sm. in *Jour. Arnold Arb.* 31: 315. 1950; Yuncker in *Bishop Mus. Bull.* 220: 188. 1959; J. W. Parham, *Pl. Fiji Isl.* 134. 1964, ed. 2. 194. *fig.* 58. 1972. FIGURES 44–48.

Tree to 28 m. high, the branchlets 1.5–3 mm. in diameter toward apex; petioles 4–20 (–25) mm. long; leaf-blades thin-coriaceous, oblong-ovate to elliptic, (5–) 7–17 cm. long, (3–) 4–11 cm. broad, obtuse at base and short-decurrent on the petiole, obtuse at apex or broadly cuspidate and often emarginate, entire and slightly thickened-recurved at margin, the costa stout, plane or broadly elevated and sometimes shallowly canaliculate above, prominent beneath, the secondary nerves usually 2 or 3 per centimeter, spreading, with lesser ones sometimes interspersed, usually obvious and prominulous on both sides, rarely subimmersed, inconspicuously joined in a collecting nerve 0.5–1 mm. within margin, interconnected by an irregular but often obvious veinlet-reticulation; inflorescences axillary, often to caducous leaves, fasciculate, composed of 1–5 (usually 1 or



2) flowers arising from a pulvinate peduncle, this rarely irregularly terete and to 5 mm. long, the flower-subtending bracts subcoriaceous, oblong, 1–2 mm. long and broad, obtuse, caducous; pedicels subterete, 3–12 mm. long at anthesis and to 15 mm. long in fruit, ebracteolate or sometimes bearing a pair of bracteoles resembling the bracts below middle, distally swollen into an inconspicuously flattened receptacle; flower buds subglobose, 5–7 mm. in diameter just prior to anthesis, the perianth composed of 2, 3, or 4 decussate pairs of segments; sepals usually 4, rarely 2, broadly imbricate, thin-coriaceous, suborbicular,  $3-5 \times 4-7$  mm., rounded and entire, with 12–15 freely branching veins, these immersed or inconspicuous, the inner sepals (if present) slightly smaller; petals 2 or 4, subcar-nose or submembranaceous, suborbicular or obovate,  $3-6 \times 3-7$  mm., rounded, undulate or faintly erosulous, flabellinerved with 12–25 irregularly dichotomously branched veins, these sometimes obscure or subim-mersed; ♂ flowers with an androecium composed of 500–700 anthers aggregated into 4 phalanges opposite the petals, these dendroid, irregularly several-times branched, the anthers borne on both inner and outer sur-faces, subglobose, 0.2–0.3 mm. long and broad, the gynoecium present as a slender, terete, sterile ovary sometimes with a capitate-discoïd stigma 2–2.5 mm. in diameter; ♀ flowers with a car-nose oblong-subglobose ovary 1.5–2 mm. in diameter at anthesis, the dissepiment thin, the locules 2, the stigma strictly sessile, car-nose, pulvinate-discoïd, 1.5–2.5 mm. in diameter, often obscurely scrobiculate, the androecium in ♀ flowers composed of 2 or 4 car-nose short-oblong phalanges, these 0.5–0.7 mm. long, about 2 mm. broad, marginally bearing a few minute sessile staminodia; fruits car-nose at maturity, oblong-ellipsoid, 20–45 mm. long, 15–30 mm. broad, surmounted by the persistent stigma, this accrescent to 7 mm. in diameter, the pericarp 0.5–2 mm. thick, often becoming brittle in drying, the dissepiment persistent, the locules 2; seeds oblong, filling the locules, the testa brittle.

TYPE LOCALITY: Southern slopes of Nausori Highlands, Nandronga & Navosa Province, Viti Levu, Fiji; the type is *Smith 4573*, cited below.

DISTRIBUTION: Fiji and Tonga, now known to occur with some frequency on high islands of the former group, but known only on Kao and 'Eua in the latter. In both archipelagoes the species is found at elevations above 50 m., in Fiji up to 915 m. and in Tonga up to 400 m., in primary, secondary, open, or rocky forest, sometimes on limestone. It has been recorded as a tree 3–28 m. high, sometimes spreading or slender, with a trunk up to 41 cm. in diameter and with yellow or brownish latex; the flowers are white or greenish white, and the fruit turns greenish white to dull yellow, red-tinged, or purple at maturity. Flowers and fruits may be anticipated in any season.

LOCAL NAMES AND USES: The species is uniformly known in Fiji as *laumbu*, and it is considered a timber tree, often used as posts for houses and other buildings. In Tonga a local name is *jeto'omaka*, and the bark is said to be used for scenting oil.



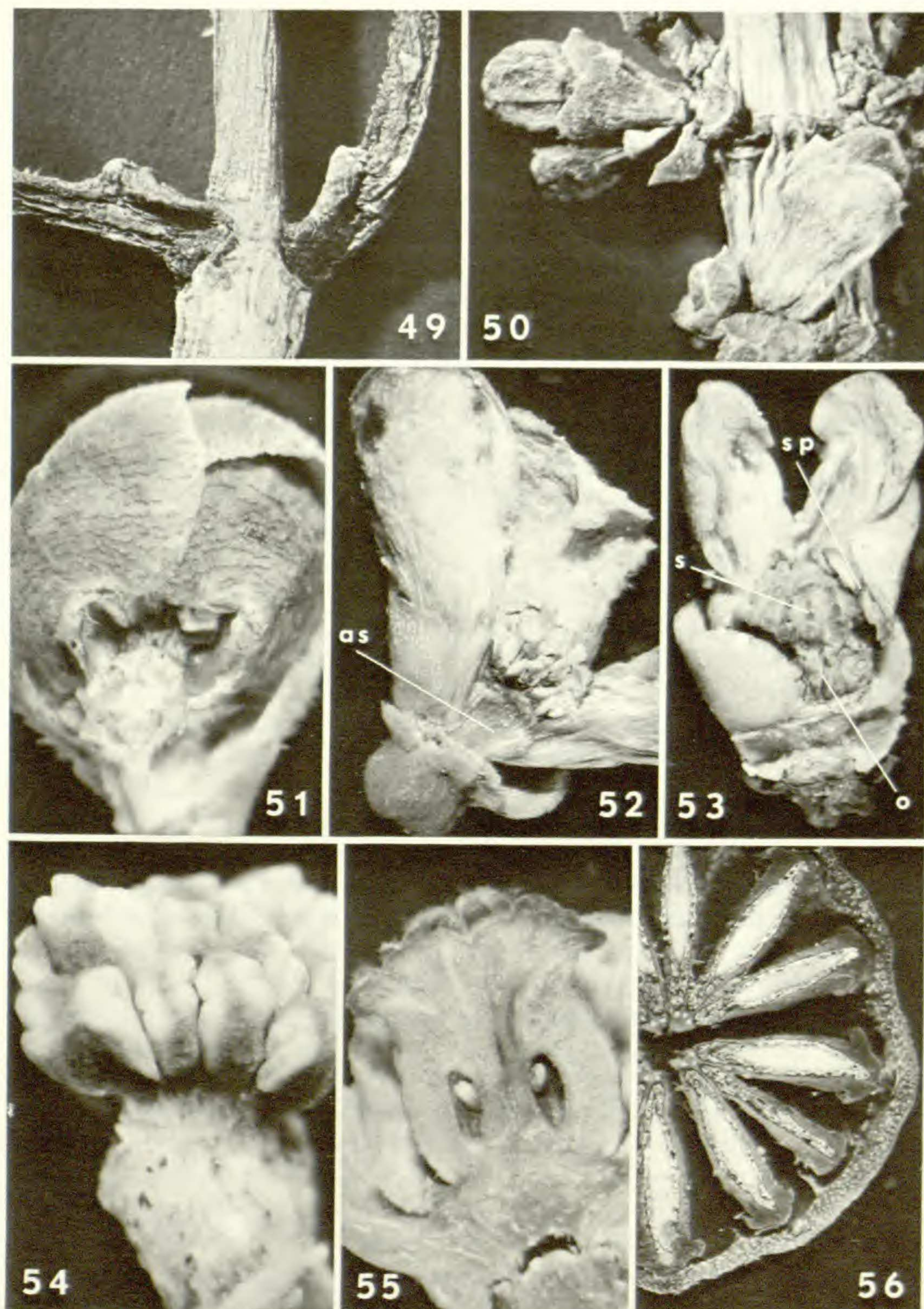
**Fiji.** VITI LEVU: MBA: Mt. Evans Range, *Greenwood* 1152 (A, BISH, K, UC, US), 1215 (BISH, UC, US); vicinity of Nandarivatu, *Mead* 1990 (K), *Gillespie* 3397 (BISH, GH, UC), 4401.2 (BISH); Sovutawambu, near Nandarivatu, *Degener* 14651 (A, BISH, NY); Mt. Tomanivi, *Smith* 5128 (A, BISH, K, NY, US). NANDRONGA & NAVOSA: *Fiji Dept. Agr.* 14298 (MASS, SUVA); Nausori Highlands, *Fiji Dept. For.* 1140 (K, SUVA), 1141 (K), *Fiji Dept. Agr.* 15607 (SUVA), 15631 (MASS, SUVA); southern slopes of Nausori Highlands, in drainage of Namosi Creek above Tumbenasolo, May 29, 1947, *Smith* 4573 (A holotype; isotypes at BISH, K, NY, US); near Vanualevu Village, *Berry* 81 (SUVA). SERUA: Upper Navua River, Vunamaravu, *Fiji Dept. Agr.* 15503 (SUVA); Navutulevu, *Fiji Dept. For.* 653 (SUVA); inland from Namboutini, *Fiji Dept. For.* R-40 (K), 816 (or 592) (BISH, SUVA), 1127 (K, SUVA), 1130 (K, SUVA), *Berry* 77 (SUVA); inland from Korovou, *Nasogiri* 12 (K); inland from Ngaloa, *Fiji Dept. For.* G-13 (K), 817 (or 593) (BISH, SUVA), 1137 (K, SUVA), 1139 (K, SUVA), *Fiji Dept. Agr.* 13778 (BISH, SUVA). NAMOSI: Between Korombasambasanga Range and Mt. Naitarandamu, *Smith* 8459 (BISH, GH, K, NY, SUVA, UC, US); northern base of Korombasambasanga Range, *Smith* 8683 (BISH, GH, K, NY, SUVA, UC, US); Saliandrau, *Fiji Dept. Agr.* 14244 (SUVA); Wairoro Creek, *Fiji Dept. Agr.* 13812 (BISH, SUVA); Nambukavesi Creek, *Damanu* NI-26 (K), *Fiji Dept. For.* 488 (SUVA), 652 (SUVA); Wainandoi River, *Vaisewa* 17 (K). NAITASIRI: Navolau Forest, *Fiji Dept. Agr.* 118 (SUVA); Navuakethe district, *Fiji Dept. Agr.* 235 (SUVA), 236 (SUVA); Waimanu River, *Fiji Dept. Agr.* 15680 (SUVA), 15836 (SUVA); Tholo-isuva, *Fiji Dept. Agr.* 12196 (SUVA), 14610 (BISH, SUVA), 16490 (BISH, MASS, SUVA); vicinity of Nasinu, *Gillespie* 3667 (BISH, GH, UC, US). KANDAVU: *Fiji Dept. Agr.* 11938 (SUVA); Naikorokoro, *Fiji Dept. For.* 651 (SUVA). VANUA LEVU: MATHUATA: Ndongotuki Tikina, *Howard* 149 (SUVA, US); Vunivia River, *Howard* 401 (SUVA). FIJI, without further locality: *Fiji Dept. Agr.* 684 (SUVA), 16495 (SUVA), *L.12633* (SUVA), *Bola* 46 (K), *Howard* 65 (SUVA).

**Tonga.** KAO: In rocky or open forest, *Yuncker* 15908 (BISH, US), 15955 (BISH, GH, US). 'EUA: *Parks* 16318 (BISH, UC); near center of island, *Yuncker* 15381 (BISH, UC, US), *Parks* 16260 (BISH, GH, UC); east of Pangai, *Hürlimann* 151 (US); Powell Plantation, *Parks* 16005 (BISH, UC); between Fuai and eastern ridge, *Hürlimann* 174 (US); top of eastern ridge, *Hürlimann* 258 (US).

*Garcinia myrtifolia*, originally described from two ♀ specimens, is now well known from abundant material obtained in Fiji and Tonga. Its relationship is definitely with *G. vitiensis*, from which only differences of degree distinguish it. However, it is usually recognizable even when sterile by its comparatively large, obtuse, more obviously nerved, and longer-petiolate leaves. Its flowers and fruits are larger than those of *G. vitiensis*, and its androecia are more obvious in the ♀ flowers. Staminate flowers are not yet known for *G. vitiensis*, but one may anticipate that they also will show slight androecial differences.

4. *Garcinia sessilis* (Forst. f.) Seem. Viti, 433. 1862, Fl. Vit. 10. 1865; Horne, A Year in Fiji, 262. 1881; Pierre, Fl. For. Cochinch. 1: XXVII. 1883; Hemsl. in Jour. Linn. Soc. Bot. 30: 169. 1894; Engl. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 21: 226. 1925; Christophersen in Bishop Mus. Bull. 128: 149. 1935; Yuncker in op. cit. 220: 189. 1959; J. W. Parham, Pl. Fiji Isl. 135. 1964, ed. 2. 195.





FIGURES 49-56. *Garcinia sessilis*: 49 from *Kajewski* 564, 50 from *Smith* 8588, 51 and 54 from *Yuncker* 16118, 52, 53, and 55 from *Setchell & Parks* 15560a, 56 from *Greenwood* 936. 49, young branchlet and petiole-bases,  $\times 5$ ; 50, young  $\delta$  inflorescences,  $\times 5$ ; 51,  $\delta$  flower bud, with sepals and 1 petal removed,  $\times 10$ ; 52,  $\delta$  flower, with 2 sepals and 1 petal removed,  $\times 5$ ; 53,  $\eta$  flower, with



1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 111. 1972. FIGURES 49–56.

*Clusia sessilis* Forst. f. Fl. Ins. Austr. Prodr. 74. 1786.

*Garcinia roxburghii* sensu Seem. in Bonplandia 9: 254. 1861; non Wight.

*Garcinia* sp. n. Horne, A Year in Fiji, 262. 1881.

Tree to 20 m. high, the branchlets 1–2.5 mm. in diameter toward apex; petioles slender, 5–20 mm. long, the basal cavity remaining obvious and sometimes distally cucullate; leaf-blades chartaceous to membranaceous, infrequently thin-coriaceous, elliptic to ovate- or obovate-elliptic, (4–) 6–15 cm. long, (1.5–) 3–7.5 cm. broad, obtuse to acute at base and decurrent on the petiole, cuspidate to acuminate at apex (tip to 15 mm. long, obtuse to acute, sometimes slender), entire and narrowly recurved at margin, often with apparent secretory canals sinuously parallel to the secondary nerves, the costa shallowly canaliculate to slightly raised above, prominent beneath, the secondary nerves 1–3 per centimeter, subascending, prominulous on both sides, irregularly anastomosing toward margin but not joined by a symmetrical collecting nerve, interconnected by a lax veinlet-reticulation; inflorescences axillary, often to caducous leaves, glomerulate-fasciculate, usually composed of 3–9 flowers arising from an irregularly subglobose or short-cylindric peduncle, this 1–5 mm. long and 1–3 mm. in diameter, the flower-subtending bracts subcoriaceous, ovate or deltoid, 1–1.5 × 1–2 mm., obtuse, usually paired at base of each flower; flowers essentially sessile or borne on pedicels rarely as long as 2.5 mm., these becoming stout in fruit but remaining inconspicuous, ebracteolate or sometimes bearing a pair of bracteoles slightly larger than the bracts; flowers ellipsoid in bud and 3–5 mm. in diameter, at anthesis spreading to 16 mm. in diameter, the perianth composed of 4 decussate pairs of segments; calyx cupuliform, the sepals 4, broadly imbricate, chartaceous or thin-carnose, longitudinally traversed by numerous parallel subsinuous secretory canals, broadly orbicular or reniform, 1.7–4 × 2–5 mm., rounded, entire, persistent in fruit; petals 4, appearing subvalvate in very young bud but soon becoming marginally imbricate and then broadly imbricate, centrally thick-carnose, thin-margined, cruciate and spreading at anthesis, oblong or obovate, 5–8 × 3–6 mm., rounded at apex, obscurely erosulous, with longitudinal sinuously parallel secretory canals; ♂ flowers with a central androecium 2–3 mm. long, this composed of 7–30 stamens fused into a carnose subquadrangular stalk 1–2 mm. long and broad, the anthers sessile or essentially so on apex of androecial stalk, oblong-obovoid, 0.6–1.2 mm. long, 0.4–0.7 mm. broad, the thecae 2, longitudinal, subequal to the truncate connective, the gynoecium none; ♀ flowers with a thick-carnose oblong gynoecium about 3 mm. long at anthesis, the ovary ellipsoid-cylindric, the locules (6–) 10–13, the stigma sessile, pulvinate-discoid, about 2.5 mm. in diameter, copiously and conspicuously tuberculate with

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2 sepals and 2 petals removed, × 5; 54, androecium, × 20; 55, section through gynoecium, × 10; 56, cross section of fruit, × 2. as = androecium-stalk; sp = sterile phalange; s = stigma; o = ovary.



projections 0.2–0.4 mm. long, marginally irregularly (6–) 10–13-lobed, the androecium in ♀ flowers composed of 4–7 phalanges adherent to the petals but irregular in respect to them, each phalange 2–3 mm. long and with 1–4 terminal anthers, these resembling those of ♂ flowers but sterile; fruits carnose at maturity but drying strongly (6–) 10–13-costate, subglobose to ellipsoid, sometimes imperfectly developed and oblique, up to 50 mm. long and broad, surmounted by the persistent stigma, this slightly accrescent to 4 mm. in diameter, the exocarp thin, the mesocarp carnose when fresh, drying subcoriaceous, 0.5–1.5 mm. thick, becoming spongy inward between the (6–) 10–13 pyrenes and there dissipating into air-chambers, the pyrenes narrowly oblong and laterally compressed or lunate, up to  $30 \times 10 \times 4$  mm., acute to obtuse on the inner edge, obtuse to narrowly rounded dorsally, separated by air-chambers in dried fruits, the endocarp of each pyrene bony, 0.2–1 mm. thick, usually distinct but sometimes interconnected by lateral protrusions toward the outer edge, the seeds laterally compressed and lunate, the outer layer of the testa spongy and resiniferous, compressed by the developing seeds.

TYPE LOCALITY: Tongatapu Island, Tonga; the type material was obtained by the Forsters on Cook's Second Voyage. The BM specimen, cited below, may be taken as the lectotype.

DISTRIBUTION: Santa Cruz Islands, Fiji, Tonga, and Samoa; now known from many collections in Fiji and Tonga, occurring from sea-level to (in Fiji) 1,150 m., in dense or dry forest, open thickets, and on edges of mangrove swamps. It has been noted as a tree 4–20 m. high, with a trunk diameter of 30 cm. and with abundant yellowish latex. The petals are pale yellow and pink-tinged to coral-red or carmine; the ovary and stigma are green at anthesis; the fruits are yellowish white to red at maturity, the pyrenes being embedded in white pulp. Flowers and fruits have been noted throughout the year in Fiji. The species is known to us from only single collections in both the Santa Cruz Islands and Samoa. The material from Vanikoro is sterile, with old glomerulate inflorescences from which the flowers have fallen, but there seems no reason to doubt its identity or its indigenoussness. The occurrence of *Garcinia sessilis* in the Solomon Islands is indicated by Whitmore (1966: 183), but such specimens have not been examined. The Samoan collection certainly represents the species and was obtained from hillside forest near Apia. Because the species is rare in Samoa, and because of the similarity to Tongan collections in its local name and uses, one may question the indigenous occurrence of the species in Samoa; it may have become sparingly naturalized there from a cultivated introduction.

LOCAL NAMES AND USES: The usual names for this taxon in Fiji are *mbuluwai* or *laumbu*, but also recorded are *mbulumangayalewa* and *elala*, the last from Kambara and perhaps reflecting Tongan influence. The species is considered a timber tree in Fiji and is used in house construction. In Tonga the staminate plant is known as *heilala* and the pistillate as *bulu*; the faintly fragrant flowers are there used in necklaces and the leaves are



said to be used medicinally. Eames reports the Samoan name as *seilala* and states that the bark is used medicinally. In both Tonga and Samoa the flowers are used to scent oil.

**Santa Cruz Islands.** VANIKORO: *Kajewski 564* (A).

**Fiji.** VITI LEVU: MBA: Mountains near Lautoka, *Greenwood 936* (A, BISH, K), *936A* (A, BISH, K, P); slopes of escarpment north of Nandarivatu, *Smith 6268* (A, BISH, K, NY, US); vicinity of Nandarivatu, *Parks 20661* (BISH, SUVA, UC), *Gillespie 4331* (BISH, GH, UC, US); Waimongge Creek, Nandrau track, *Berry 86* (BISH, MASS, SUVA). NANDRONGA & NAVOSA: North of Komave, *St. John 18951* (BISH, US). SERUA: Between Navua River and Wainiyavu Creek, near Namuamua, *Smith 9020* (BISH, GH, K, NY, SUVA, UC, US); inland from Ngaloa, *Smith 9205, 9411* (both BISH, GH, K, NY, SUVA, UC, US), *Fiji Dept. Agr. 14118* (SUVA). NAMOSI: Vicinity of Wainimakutu, Wainavindrau Creek, *Smith 8588* (BISH, GH, K, NY, SUVA, UC, US); vicinity of Namosi, *Seemann 51* (BM, GH, K, P); vicinity of Namuamua, *Gillespie 3021* (BISH, GH, UC), *3055* (BISH, GH, NY, UC, US). NAMOSI-NAITASIRI boundary: Mt. Naitarandamu, *Gillespie 3245* (BISH, UC). RA: Vicinity of Nasukamai, *Gillespie 4692.3* (BISH, GH, UC). NAITASIRI: Vicinity of Viria, *Meebold 17065* (K), *18501* (K); Central Road, *Tothill 401* (K); vicinity of Nasinu, *Gillespie 3636* (BISH), *3665* (BISH, GH, NY, UC, US). OVALAU: Lovoni Valley, *Horne 185* (GH, K), *Fiji Dept. Agr. 13297* (SUVA). VANUA LEVU: MATHUATA: Near Mt. Ndrandramea, *Fiji Dept. Agr. 15387* (A, SUVA). TAVEUNI: Vicinity of Wairiki, *Gillespie 4757* (BISH, GH, NY, UC). VANUA MBALAVU: Northern limestone section, *Smith 1482* (BISH, GH, K, NY, UC, US). KAMBARA: On limestone, *Smith 1274* (BISH, GH, K, NY, UC, US).

**Tonga.** VAVA'U: *Wilder*, June 28, 1925 (BISH); near Houma, *Yuncker 16118* (BISH, GH, US). NOMUKA: Between sea and central lake, *Yuncker 15864* (BISH, US). TONGATAPU: *J. R. & G. Forster* (BM lectotype); Vaikele, experimental gardens, loose ♂ and ♀ flowers from different plants, *Setchell & Parks 15560a* (UC); vicinity of Nuku'alofa, *Setchell & Parks 15178* (NY, UC), *15235* (BISH, GH, UC, US); near Bea, *Setchell & Parks 15560* (UC), *15600* (UC); near Haake, *Setchell & Parks 15347* (UC); below Lavagatoga, *Yuncker 15177* (BISH, US). 'EUA: Near Pangai, *Yuncker 15464* (BISH, US); plantation area, M'ua, *Bristol 1912* (BISH). TONGA, without further locality: *McKern 33* (BISH), *78* (BISH).

**Samoa.** UPOLU: Vicinity of Apia, *Eames 71* (BISH, NY).

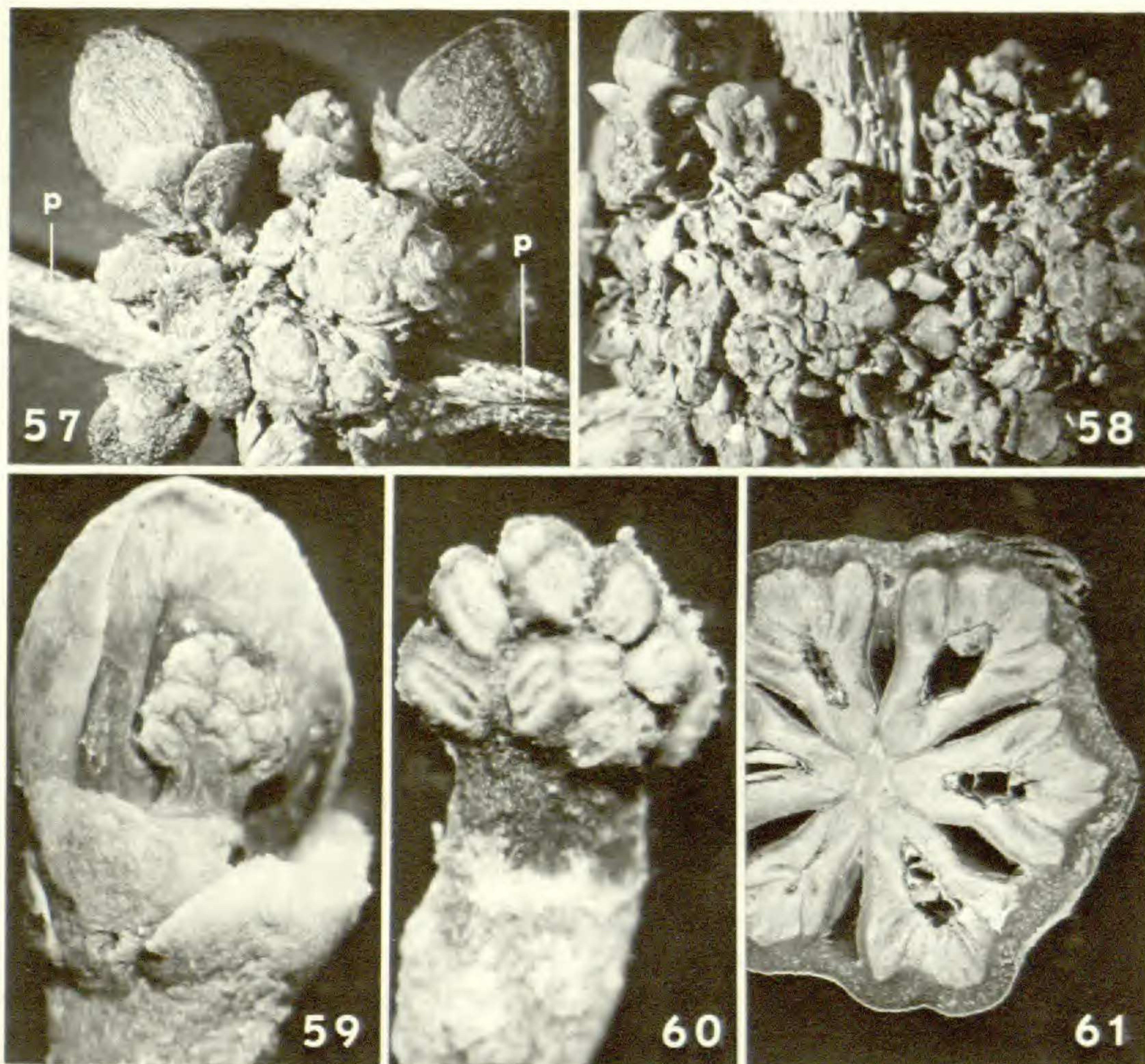
The androecium (FIGURE 54) of *Garcinia sessilis* is composed of a central stalk bearing sessile or essentially sessile anthers on its summit, the anthers not being appreciably grouped into four short fascicles. In the ♀ flowers, the sterile androecium (FIGURE 53) is indeed composed of separate fascicles appressed to the petals, but apparently Pierre's 1883 treatment was based entirely on *Seemann 51*, a ♂ collection. In that treatment Sect. TETRACLINIA was described on the sole basis of *G. sessilis*. This section now seems unnecessary; in Engler's (1925) system *G. sessilis* seems in all respects to fall into Sect. MUNGOTIA.

## 5. *Garcinia adinantha* A. C. Sm. & S. Darwin, sp. nov. FIGURES 57–61.

*Garcinia* sp. n. Horne, A Year in Fiji, 262. 1881.

Arbor ad 20 m. alta, ramulis apicem versus 1.5–4 mm. diametro; petiolis (2–) 7–25 mm. longis, foliorum laminis subcoriaceis vel chartaceis, ellipti-





FIGURES 57–61. *Garcinia adinantha*: 57, 59, and 60 from *Smith 1827*, 58 from *Smith 9372*, 61 from *Smith 1644*. 57, ♂ inflorescences at distal node,  $\times 5$ ; 58, ♂ inflorescences from older branchlet,  $\times 5$ ; 59, ♂ flower, with 1 petal removed,  $\times 10$ ; 60, androecium,  $\times 20$ ; 61, cross section of fruit,  $\times 2$ . p = petiole.

cis vel ovato- vel elliptico-lanceolatis, (4–) 7–19 cm. longis, (1.5–) 3–7.5 cm. latis, basi acutis vel attenuatis et in petiolum longe decurrentibus, apice breviter cuspidatis (raro late obtusis) vel gradatim acuminatis (apice ipso obtuso, 5–20 mm. longo), integris, canalibus secretoriis manifestis inter nervos secundarios sinuose parallelis interdum ornatis, costa crassa supra elevata vel plana et interdum vadosae canaliculata subtus prominente, nervis secundariis 1–3 per centimetrum subadscendentibus utrinque prominulis marginem versus irregulariter anastomosantibus rete venularum obscure reticulato immerso vel interdum subtus leviter prominulo interconnexis; inflorescentiis axillaribus vel supra cicatrices foliorum caducorum enatis, glomerulato-fasciculatis, plerumque 15–40 (raro distalibus 3–7)-floris, floribus e pedunculo semigloboso cicatricibus florum caducorum verruculoso orientibus, flore ipso bracteis 2 vel pluribus congestis late deltoideis 0.5–2  $\times$  1–2 mm. obtusis caducis subtento; floribus subsessilibus vel pedicellis ebracteolatis 1–1.5 mm. longis et diametro; floribus ♂ solum



visis in alabastro vetere ellipsoideis 4–5 mm. diametro; calyce vadose cupuliformi, sepalis 4 decussatis subcarnosis orbicularibus vel late ovatis,  $1.5-2 \times 1.5-3$  mm., apice rotundatis vel late obtusis, minute erosulis, sub fructu persistentibus; corollae alabastro inconspicue carinato, petalis 2 carnosus valvatis ellipticis  $5-6 \times 4-5.5$  mm. apice rotundatis lateraliter inter se late adpressis; androecio simplici 1–2.5 mm. longo, staminibus 8–20, stipite carnosus subtereti 0.6–2 mm. longo basim petalorum adpresso, antheris sessilibus subquadrato-ellipsoideis, 0.4–0.7 mm. longis, 0.3–0.5 mm. latis, thecis 2 longitudinalibus connectivo truncato subaequalibus, gynoecio nullo; fructibus in vivo carnosus in sicco obtuse 5–8-costatis ellipsoideis interdum inaequilateralibus, maximis visis ad  $35 \times 25$  mm. stigmatibus persistentibus ornatis, eo sessili discoideo 2–3 mm. diametro conspicue tuberculato margine 5–8-crenato, endocarpio tenui, mesocarpio in vivo 2–3 mm. crasso et canalibus resiniferis perducto demum spongioso et in cavernulas aeras inter pyrenas 5–8 dissipato, pyrenis oblongo-cuneiformibus ad  $25 \times 10 \times 8$  mm. margine interiore obtusis exteriori irregulariter rotundatis in sicco cavernulis aeriis separatis, endocarpio pyrenae omnis corneo 1–4 mm. crasso, seminibus complanato-lunatis, testae strato exteriori spongioso resinifero semine crescenti compresso.

TYPE LOCALITY: Mt. Kasi, Yanawai River region, Thakaundrove Province, Vanua Levu, Fiji; the type is *Smith 1827*, cited below.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu and Vanua Levu, occurring at elevations of 50–1,050 m. in dense or dry forest. It has been recorded as a tree 3–20 m. high, with yellow latex; the young petals vary from salmon-pink to dull red. Flower buds have been obtained throughout the year, and fruits in April and May.

LOCAL NAMES AND USE: Names recorded from Vanua Levu are *raumba*, *mbulu*, *mbulumanga*, and *mbulumangayalewa*. Like the related *Garcinia sessilis*, it is considered a useful timber tree.

Fiji. VITI LEVU: MBA: Nandende Levu, Mt. Evans Range, *Fiji Dept. Agr. 14835* (BISH, SUVA); northern portion of Mt. Evans Range, between Mt. Vatunianitu and Mt. Natondra, *Smith 4379* (A, BISH, K, NY, US). SERUA: Hills between Waininggere and Waisese Creeks, between Ngaloa and Wainiyambia, *Smith 9372* (BISH, GH, K, NY, SUVA, UC, US). NAMOSI: Mt. Vakarongasiu, *Gillespie 3256* (BISH, GH, UC), *Fiji Dept. Agr. 14704* (BISH, SUVA), *16129* (SUVA). NAITASIRI: Vicinity of Navuso, *Fiji Dept. Agr. 12595* (MASS, SUVA); vicinity of Tamavua, *Gillespie 2042* (BISH, UC). REWA: Vicinity of Na Vasi, *Horne 734* (GH, K). VANUA LEVU: MBUA: Navotuvotu, summit of Mt. Seatura, *Smith 1644* (BISH, GH, K, NY, UC, US); Tambulotu, Wainunu Valley, *Fiji Dept. Agr. 15754* (SUVA); vicinity of Thongea, Wainunu River, *Fiji Dept. Agr. 15768* (SUVA), *15771* (BISH, SUVA, US). MATHUATA: Vicinity of Nasingasinga, *Berry 53* (SUVA), *54* (SUVA). THAKAUNDROVE: Mt. Kasi, Yanawai River region, May 11, 1934, *Smith 1827* (BISH holotype; isotypes at GH, K, NY, UC, US). FIJI, without further locality: *Berry 30* (SUVA).

This new taxon is proposed with a certain amount of diffidence, but we believe it unwise to expand the concept of *Garcinia sessilis* to include it.



Several of the cited specimens bear young ♂ flowers, the most advanced being those of the type collection. All flowers examined have only two petals, whereas all flowers of specimens included by us in *G. sessilis* have four petals. In *G. vitiensis* and *G. myrtijolia*, as noted above, we have included in our concepts both 2-petalled and 4-petalled plants, but there the petals are similarly imbricate in both instances. The two petals of *G. adinantha*, however, are valvate and with tightly appressed thick margins (FIGURE 59), at least in advanced bud, whereas the four petals of *G. sessilis* in a similar stage of development (FIGURE 51) are already broadly imbricate and thin-margined. The two taxa have otherwise different facies, *G. adinantha* having comparatively thick-textured leaf-blades that tend in general to be more gradually narrowed at the base and long-decurrent on the petiole, whereas those of typical *G. sessilis* are thinner in texture and less tapering basally. The ♂ flowers of the new species are the more numerous (FIGURE 58), usually 15–40 per congested, multibracteate inflorescence, while those of *G. sessilis* are fewer in number (FIGURE 50) and rarely with more than two subtending bracts per flower. On the basis of the fruits now available there are also differences between the two taxa. Of *G. adinantha*, only *Smith 1644* and *4379* bear fruits, but several fruiting collections of *G. sessilis* are available. The fruits of *G. sessilis* (FIGURE 56) typically have a mesocarp 0.5–1.5 mm. thick and dry to a sharply 10–13-costate (rarely 6-costate) form; the 10–13 (rarely as few as 6) pyrenes have bony endocarps 0.2–1 mm. thick and are obtuse to narrowly rounded dorsally. The fruits of *G. adinantha* (FIGURE 61), in contrast, have a mesocarp 2–3 mm. thick and dry to an obtusely 5–8-costate form; the 5–8 pyrenes are comparatively broad and rounded on the dorsal face and have horny endocarps 1–4 mm. thick.

Of the cited collections, *Gillespie 2042* and *3256* and *Fiji Dept. Agr. 14704* are extreme in their small, short-petiolate leaves with very conspicuous secretory canals, but in other respects, including flower buds with two petals, they agree with the concept here outlined.

#### CULTIVATED SPECIES

*Garcinia dulcis* (Roxb.) Kurz in Jour. Asiat. Soc. Bengal 43(2): 88. 1874.

*Xanthochymus dulcis* Roxb. Pl. Coromand. 3: 66. t. 270. 1820.

No herbarium record supports the occurrence in our area of this Malesian tree, but it has been observed in the Botanical Gardens in Suva, Fiji.

*Garcinia mangostana* L. Sp. Pl. 443. 1753; J. W. Parham, Pl. Fiji Isl. 134. 1964, ed. 2. 192. 1972.

Fiji. VANUA MBALAVU: Lomaloma Botanical Gardens, *Fiji Dept. Agr. 10212* (SUVA).

The Malesian *mangosteen*, while not easy to establish outside its native area, was successfully introduced in Fiji in the 1880's and a few trees are still to be seen there.



*Garcinia xanthochymus* Hook. f. Fl. Brit. Ind. 1: 269. 1874; J. W. Parham, Pl. Fiji Isl. ed. 2. 195. 1972.

Fiji. VANUA LEVU: MATHUATA: Lambasa, *Fiji Dept. Agr. L.11589* (SUVA).  
Samoa. Without definite locality: *Guest 8* (BISH).

The *sour mangosteen*, a native of southeastern Asia, is probably moderately common in cultivation in Fiji.

*Mammea americana* L. Sp. Pl. 512. 1753; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 102. 1948, Pl. Fiji Isl. ed. 2. 195. 1972.

Fiji. VITI LEVU: REWA: Suva, *Fiji Dept. Agr. 3126* (SUVA).  
Samoa. Without definite locality: *Guest 1* (BISH), 4 (BISH).

The American *mammey apple* or *mammee apple* is now widely cultivated throughout the tropics as an ornamental tree.

*Mesua ferrea* L. Sp. Pl. 515. 1753.

Fiji. VITI LEVU: NAITASIRI: Nanduruloulou, *Fiji Dept. Agr. 5523* (SUVA).

This Indo-Malesian tree, with many uses in its native area, was probably experimentally introduced into Fiji, but it may no longer occur there in cultivation.

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